

A star (*) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

3882. Probability of Radiative Transitions in Nuclei. B. Pontecorvo. *Comptes Rendus*, 207. pp. 230-232, July 18, 1938.—Arguments are adduced in support of the view that the probability per unit of time of radiative dipole or quadrupole transitions is ordinarily of the order of 10^{12} – 10^{13} sec⁻¹. C. A. S.

3883. Deviation of the Nuclei of ${}^4\text{He}$ and ${}^{16}\text{O}$ from the Hartree Model. B. O. Grönblom. *Zeits. f. Physik*, 110. 1-2. pp. 37-57, 1938.—A method of calculating the second-order perturbation energies of the two light nuclei ${}^4\text{He}$ and ${}^{16}\text{O}$, taking into account nuclear forces in their relation to nuclear structure, is presented. In the case of ${}^{16}\text{O}$ it is shown that the fraction of the mass-defect which is explainable on theoretical lines is thus increased from 26.5% to 51.5%. By an extension of the work of Nakabayasi, and Inglis and his own work, the author is able to express the nuclear energy not only as the first member of a series in the case of heavy nuclei but by means of a closed expression; this enables corrections to be applied to results previously obtained. J. S. G. T.

3884. Separation of Isotopes. F. W. Aston. *Science and Culture*, 4. pp. 22-23, July, 1938.—A brief summary of the chief methods tried in succession for the separation of isotopes from the time of their discovery. N. M. B.

3885. New Method for Separating Isotopes. A. Kastler. *Comptes Rendus*, 207. pp. 146-148, July 11, 1938.—The new method is based on the fact that the metastable atomic levels of the various isotopes of the same element may have very different durations of life. The method has not yet been actually tried, and would involve two successive electronic bombardments of an atomic jet. C. A. S.

3886. Electron Diffraction Examination of Linear High Polymers. K. H. Storks. *Am. Chem. Soc., J.* 60. pp. 1753-1761, Aug., 1938.—Electron diffraction experiments have been carried out upon very thin films of several synthetic polyesters and natural gutta-percha. Stretched films show diffraction patterns characteristic of sharply oriented crystals. Measurements upon these patterns are in excellent agreement with existing X-ray data upon the same materials. The utility of the electron diffraction method for structural studies of polymerised substances is thus demonstrated. Unstretched films of gutta-percha are found to be composed of relatively large crystallites which are precisely oriented with their fibre axis directions normal to the film surface. It is presumed that the macromolecules are folded back and forth upon themselves in such a way that adjacent sections remain parallel. Unstretched films of polyethylene sebacate consist of relatively small crystals which are believed

to be oriented with their fibre axis directions approximately in the plane of the film, but with limited rotation around the fibre axis directions.

AUTHOR.

3887. Magnetic Properties and Structure of Manganous and Cobaltous Dipyrindine Chlorides. D. P. Mellor and C. D. Coryell. *Am. Chem. Soc., J.* 60. pp. 1786-1787, Aug., 1938.—The magnetic criterion for bond type indicates that Mn and Co atoms in the dipyrindine dichloride compounds form ionic bonds rather than covalent dsp^2 bonds. It is suggested that an octahedral ionic type of structure occurs in the Mn and α -Co compound and a tetrahedral ionic type occurs in the β -Co compound.

AUTHORS.

3888. Molecular Structure of As_4O_6 , P_4O_6 , P_4O_{10} , and $(CH_3)_3N_4$. G. C. Hampson and A. J. Stosick. *Am. Chem. Soc., J.* 60. pp. 1814-1822, Aug., 1938.—Electron diffraction measurements on arsenious oxide, phosphorus trioxide and hexamethylenetetramine show that the molecules consist of four P or N atoms in positions (vvv) (vvv) (vvv) and (vvv) and six O atoms or methylene groups in the positions ($\pm u00$) ($0 \pm u0$) and ($00 \pm u$). In P_4O_{10} there are four additional O atoms in the positions (www) (www) (www) and (www). The interatomic distances and angles are: for As_4O_6 , As-O = 1.80 ± 0.02 Å, O-As-O = $100 \pm 1.5^\circ$, As-O-As = $126 \pm 3^\circ$, for P_4O_6 , P-O = 1.65 ± 0.02 Å, O-P-O = $99 \pm 1^\circ$, P-O-P = $127.5 \pm 1^\circ$, for $N_4(CH_3)_6$, C-N = 1.47 ± 0.02 Å, C-N-C = 109.5° , for P_4O_{10} , P-O = 1.62 ± 0.02 Å, P-O' = 1.39 ± 0.02 Å, O-P-O = $101.5 \pm 1^\circ$, P-O-P = $123.5 \pm 1^\circ$ and O-P-O' = $116.5 \pm 1^\circ$. The shortening of the bond distances in As_4O_6 , P_4O_6 and P_4O_{10} below the theoretical single-bond values is attributed to single-bond double-bond resonance. It is concluded that the abnormally low value of 1.39 Å for the P-O' bond in P_4O_{10} is due to the polar character of the bond.

AUTHORS.

3889. Structures of P and Si Compounds. L. O. Brockway and J. Y. Beach. *Am. Chem. Soc., J.* 60. pp. 1836-1846, Aug., 1938.—The molecular structures of seven P compounds have been investigated. The P-F bond distances in the PX_3 and POX_3 (X = halogen) molecules are all close to 1.52 Å, and in PF_5 and PF_5Cl_2 are 1.57 and 1.59 Å. An increase in bond length with coordination number occurs at coordination number five but not four. The observed lengths are all smaller than the covalent radius sum, 1.74 Å. The P-Cl bond lengths show similar variations but the decreases below the radius sum, 2.09 Å, are only from 0.04 to 0.08 Å. The XPX bond angles increase by 4° in going from PX_3 (102°) to POX_3 (106°). The P-O bond, 1.56 Å in length, is a double bond and stands at angles of 112° to the three P-X bonds. In Si_2H_6 the Si-Si bond length is 2.32 ± 0.03 Å, within 0.02 Å of the length in elementary silicon. In $SiHCl_3$ and Si_2Cl_6 the Si-Cl bonds are 2.01 ± 0.03 Å, and 2.00 ± 0.05 Å; the same value has been observed in $SiCl_4$. This value is 0.16 Å below the Si-Cl radius sum. The ClSiCl angle in $SiHCl_3$ is distorted from the tetrahedral value by less than 1° .

AUTHORS.

3890. Structure of $AlCl_3$, $AlBr_3$ and AlI_3 . K. J. Palmer and N. Elliott. *Am. Chem. Soc., J.* 60. pp. 1852-1857, Aug., 1938.—It is shown that in the gaseous state the dimeric molecules of aluminium chloride, bromide, and iodide consist of two tetrahedra sharing an edge with six halogen atoms at the corners, each tetrahedron containing one Al atom. The final values of the interatomic distances are given.

AUTHORS.

3891. Molecular Structures of CF_4 and SiF_4 . C. R. Bailey, J. B. Hale and J. W. Thompson. *Roy. Soc., Proc.* 167A, pp. 555-566, Sept. 23, 1938.—The infra-red absorption spectra of gaseous CF_4 and SiF_4 have been examined between 1 and $18\ \mu$ with a prism spectrometer. Data obtained for the Raman spectra by other workers have helped in the assignment of fundamental modes and combination tones. The Urey and Bradley force system provides a satisfactory picture of the two molecules, and the force constants for this and other systems have been calculated. The molecular structures are discussed with particular reference to the interatomic distances and extent of electron pair bond formation.

AUTHORS.

3892. Structure of Dihalogen Derivatives of Cyclohexane. J. G. Gudmundsen and O. Hassel. *Zeits. f. phys. Chem.* 40. Abt. B. 5. pp. 326-332, 1938.—The results of electron diffraction experiments with the vapours of dichloro-, dibromo-, and diiodo-cyclohexane are given.

A. J. M.

3893. Allotropes of S. S. R. Das. *Indian Journ. Phys.* 12. pp. 163-181, May, 1938.—The modifications of S existing between -183°C . and 130°C . have been investigated by the X-ray powder photograph method with the following results:—Roll S and "flowers of sulphur" are the same as the orthorhombic form S_8 . Milk of sulphur and the so-called amorphous forms are really S_8 , but plastic S is really amorphous, though it rapidly changes into S_8 . White S obtained by the hydrolysis of S_2Cl_2 is crystalline but different from S_8 into which it is transformed if it is heated to 88°C . Using specimens of S_8 at temperatures between 80°C . and 110°C . there are obtained discontinuity of rings, asterism and the appearance of sharp spots; these effects are due to the change from S_8 to S_6 . No satisfactory results were obtained from S_6 itself. The author suggests that the insolubility of various forms of S is due to a layer of oxide on the surface of the crystallites. Liquid S was also investigated.

G. G.

3894. Molecular Association of Acetic Acid. P. Koteswaram. *Zeits. f. Physik*, 110. 1-2. pp. 118-133, 1938.—The Raman spectrum of acetic acid has been examined in solutions of H_2O , C_6H_6 , and CCl_4 . In aqueous solution a variation in the Raman frequencies is observed, which is not exhibited in the non-polar solvents. Increase in temperature, however, produces a similar variation. The variation is attributed to the decomposition of the highly polymerised acid into lower polymers which can be produced either by solution in a polar solvent or by heating. The structure of the hydrates of acetic acid is discussed.

W. R. A.

3895. Molecular Weights of Globular Proteins. D. M. Wrinch. *Phil. Mag.* 26. pp. 313-332, Sept., 1938.—The further consideration of the cyclol theory shows that its predictions and general point of view are in good accord with the findings of Svedberg. The shape of the C_α cyclols and the nature of the cyclol network suggest that compound cyclols may exist, and it is found that the actual numbers given by Svedberg for fourteen different molecular weight classes may all be represented by simple or compound cyclols on the assumption that the corresponding apparent residue weights lie between 121 and 128. The consideration of compound cyclols suggests a simple interpretation of the reversible dissociation characteristic of many proteins, and explains in particular the effect of dilution and changes in pH on the molecular weights of such

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proteins. A cage-colony structure is proposed for the virus proteins and other heavy proteins. AUTHOR.

See also Abstracts 3981, 3999, 4098, 4148, 4159, 4209, 4213.

COLLOIDS.

3896. Optical Properties of Cellulose Dispersed in Cuprammonium Hydroxide. J. Compton. *Am. Chem. Soc., J.* 60. pp. 1807-1812, Aug., 1938.—The successive lowering of the cuprammonium viscosity of native cotton fibres by the action of dilute acids or mild oxidising agents is not accompanied by a change in the optical activity of the resulting dispersions, a conclusion in agreement with the work of Hess on celluloses of low viscosity. It follows that the optical activity of cellulose dispersions in cuprammonium solutions is dependent upon the formation of a cellulose particle-copper complex. Quantitative examination of various celluloses dispersed in cuprammonium solutions, using the slit ultramicroscope, reveals the presence of approximately the theoretical number of cellulose particles ($1.1 \times 1.5 \mu$). Further evidence that cellulose-copper compound formation precedes dispersion of cellulose in cuprammonium solution is presented. Visible cellulose particles ($1.1 \times 1.5 \mu$) observed in the living cytoplasm, cellulose fibres and dispersions of cellulose in cuprammonium solution possess the essential features, with the exception of size and shape, of the hypothetical micelles. AUTHOR.

3897. Viscosity Function of Disperse Systems. F. Frimberger and J. Rehme. *Kolloid Zeits.* 84. pp. 196-199, Aug., 1938.—The representations in a plane diagram of the three variables essential to the discussion of the viscosity of disperse systems, viz., (1) the total viscosity of the disperse system as a whole, (2) the viscosity of the fluid in which the dispersion is produced, and (3) the total volume of the disperse phase, is discussed. The method is illustrated by the plotting of results relating to the viscosities of suspensions of red blood corpuscles in 3-8% citrate solution containing various proportions of gum arabic. J. S. G. T.

3898. Source of Error in Micro-Kataphoretic Measurements with a Cell of Cylindrical Bore. D. C. Henry. *Chem. Soc., J.* pp. 997-999, July, 1938.—Difficulties in locating the level of observation in a cylindrical-bore micro-kataphoretic cell of the Matson type are considered, especially in the case when the fine focusing adjustment of the microscope is used. A. J. M.

3899. Electrochemistry of Congo-Dye Sols. W. Pauli and P. Szarvas. *Kolloid Zeits.* 84. pp. 179-186, Aug., 1938.—This paper records the potentiometric determination of the H-ion activities (glass electrode) and the derivation of the activity and conductivity coefficients of the related ions of a highly purified negative hydrophobic sol, such as Congo Blue, at various dilutions. Various characteristics are described for polyvalent colloidal electrolytes (hydrophilic and hydrophobic). The neutralisation relationships for Congo-dye sols with caustic alkalies are tested also by means of potentiometric measurements in the alkaline domain. Thereby it is shown that near the neutral point every millimol of dye consumes 2 millimols of caustic alkali, and that within pH 8 to 12, a still further union of alkali takes place up to a limiting value of 4 millimols per millimol of dye, i.e., the formation of a hitherto unknown tetravalent colour anion is established. The constitutional problems involved in this proton release of the colour molecule are discussed and the possible application explored. H. H. Ho.

*3900. **Electrodialysis.** H. de Bruyn and S. A. Troelstra. *Kolloid Zeits.* 84. pp. 192-196, Aug., 1938.—The theory of electrodialysis is briefly explained, and apparatus, based upon the method due to Pauli, for the electrodialytic purification and concentration of hydrophobic sols, employing a much reduced quantity of wash-water is described and illustrated.

J. S. G. T.

3901. **Silver Chromate Banding in Silicic Acid Gel.** T. Isemura. *Chem. Soc. Japan, Bull.* 13. pp. 484-493, July, 1938.—The formation of silver chromate bands in silicic acid gel, which was made by a usual method, is described. By this procedure, the concentration of chromate is regulated at will, and distinct banding is formed. The H ion concentration of the gel has a profound influence on the formation of rhythmic band of silver chromate. Dhar and Chatterji's theory and the membrane theory are not applicable.

AUTHOR.

3902. **Calcium Phosphate Banding in Silicic Acid Gel.** T. Isemura. *Chem. Soc. Japan, Bull.* 13. pp. 493-504, July, 1938.—The formation of rhythmic precipitate of calcium phosphate in a silicic acid gel is described. It is strongly affected by the H-ion concentration of the gel. The effects of the concentrations of inner and outer electrolytes, and gel were also studied. When the concentration of the inner electrolyte (CaCl_2), is sufficiently great, no diffusion of the outer electrolyte into the gel takes place but reversely Ca salt diffused into the outer electrolyte solution and dendrites were formed in the outer solution. The effect of the existence of a third substance in the gel and in the diffusing electrolyte, was also investigated. The existence of it in a diffusing electrolyte had almost no influence but the existence in a gel had some effects, especially in the case where bromide and iodide of potassium were used as the third substance.

AUTHOR.

3903. **Quantitative Investigations on Rhythmic Precipitation.** K. Neumann and V. Costeanu. *Kolloid Zeits.* 84. pp. 130-138, Aug., 1938.—The dependence of the rhythmic precipitation of Ag_2CrO_4 in gelatin on the initial concentrations of the reagents, the acidity of the gelatin, and temperature has been investigated. The results agree with the supersaturation theory.

A. J. M.

See also Abstracts 3895, 3919, 3942, 3968, 4181.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3904. **Energy Levels in Real and Ideal Crystals.** N. F. Mott. *Faraday Soc., Trans.* 34. pp. 822-827; *Disc.*, 832-834, Aug., 1938.—An ionic crystal such as rock-salt does not show metallic conduction and may therefore be said to contain no "free" electrons. This does not mean that the electrons in the negative ions are prevented by a potential barrier from moving into an adjacent negative ion; owing to the quantum mechanical "tunnel effect" an electron can pass freely through the potential barrier separating the ions. The absence of current is due rather to the Pauli exclusion-principle; the crystal is built up of ions having the electronic configuration of a closed shell. An electron cannot pass from one ion to its neighbour because all the energy states of the latter are occupied. The conditions under which a current can exist in a polar crystal are considered. Electronic energy levels at singular points in the lattice are discussed in the light of the theories of Jost, Schottky and Wagner, according to which there exist a number of lattice points

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in a polar crystal from which the ions are missing. At high temperatures these vacant points are mobile, and are responsible for the electrolytic conduction of the salts. At lower temperatures they become immobile; the number depends on the past history of the crystal. The problem of the energy levels at the surface and at cracks, and due to colloidal metal particles are outlined.

C. J. B. C.

3905. Excited Energy Levels of Insulating Crystals. J. C. Slater. *Faraday Soc., Trans.* 34. pp. 828-832; *Disc.*, 832-834. Aug. 1938.—The wave functions for normal states of insulating crystals are well understood, but three principal theories have been put forward to explain the excited states. Electronic excitation may be caused in various ways, but only optical excitation is considered here. The first theory considers the atoms or ions in the crystal as if they were in empty space. Light can be absorbed by one of the ions or atoms of the crystal either by raising it to an excited level or ionising it. The processes by which it can return to the normal state are enumerated, and a simple theory for simple alkali halide crystals is outlined. Its shortcomings are evident when it is compared with the methods used to describe the normal states. The next stage in the development is to suppose that the process of excitation consists in the removal of an electron from one of the levels of a filled band into an unfilled level. Only finite excitation is necessary to produce conductivity in such a crystal. The normal state consisting of filled bands causes no current, but in the excited state the electron travels through the crystal and a current is possible. The more simple theory seems nearer the truth than the quantum theory based on energy bands. The refinements of the theory by the application of perturbations to the wave theory, leads to a theory of excited states similar to the simple theory and promises to give more accurate results.

C. J. B. C.

3906. Electronic Structure of Metals. J. Farineau. *Ann. de Physique*, 10. pp. 20-102, July-Aug., 1938.—Essential points of the electronic theory of metals are emphasised and the theories put forward to explain the wide bands emitted by metals in the X-ray region are reviewed critically. A theory is proposed which predicts certain particulars in the distribution of the intensity of these bands. The apparatus for the investigation of Mg, Al, and Si between 5 and 16 Å is described. The experimental data yield information on the distribution of the electrons in these metals in the crystalline state. Comparison of the results obtained using Al in the solid and liquid states reveals that the electronic structure in both states is very similar. Study of Al-Mg alloys shows that the valence electrons of the two metals are shared. The *L* bands of Co, Ni, Cu, and Zn have been studied and information on the structure of the 3*d* and 4*s* levels is obtained.

W. R. A.

3907. Atomic Vibrations in Mg. G. W. Brindley and P. Ridley. *Phys. Soc., Proc.* 50. pp. 757-766, Sept. 1, 1938.—Measurements are made of the intensities of X-ray reflections from Mg powder at 86° and 293° K. Absolute values of the ratio I_{86}/I_{293} are obtained by making comparative measurements on a composite specimen of Mg and Al powders. The results are discussed in relation to theoretical work by Zener and others on the effect of lattice vibrations in hexagonal metals on the intensities of X-ray reflections. It is shown that in Mg the lattice vibrations are almost isotropic but that the mean atomic displacements in the basal plane are about 3% greater than those parallel to the *c* axis. Values are calculated for the mean atomic displacements in these directions at 86°.

and 293° K, and the results are also expressed in terms of characteristic temperatures Θ_0 (parallel to the c axis), equal to 339°, and Θ_{90} , equal to 327°. A consideration of these results, in conjunction with similar results for other hexagonal metals, points to a correlation between the departure of the axial ratio from the ideal value 1.633 and the asymmetry of the lattice vibrations.

AUTHORS.

3908. Interaction of Atoms in Alloys. W. Shockley. *J. Chem. Phys.* 6. pp. 523-525, Sept., 1938.—A generalisation of Bethe's theory of superlattices so as to take into account the interactions between atoms which are not nearest neighbours in the lattice is considered. This process will not furnish any great improvement in agreement between theory and experiment because it predicts, in disagreement with experiment, that many properties of binary alloys are symmetrical between the two constituents. It is further shown to be in disagreement with certain fundamental features of the interactions of atoms in alloys.

AUTHOR.

3909. Al-Mg System. F. Laves and K. Moeller. *Zeits. f. Metallkunde*, 30. pp. 232-235, July, 1938.—An X-ray examination of the Al-Mg system using Cu K_α radiation shows that four intermediate phases exist (δ , δ^1 , γ , β). Hitherto only three phases have been recognised. The δ -phase has an α -Mn structure whilst the δ^1 has a similar but distorted structure. The γ - and β -phases give different X-ray patterns, each containing many lines; the β -phase pattern is very similar to that of the compound Cu_4Cd_3 . The existing phase diagram of the system is modified to take into account the four phases.

H. J. H. S.

3910. X-Ray Investigation of Slowly Cooled Cu-Ni-Al Alloys. A. J. Bradley and H. Lipson. *Roy. Soc., Proc.* 167A. pp. 421-438, Sept. 6, 1938.—From an X-ray examination of slowly cooled Cu-Ni-Al alloys, a phase diagram has been constructed. The boundaries of the single-phase, two-phase and three-phase fields have been fixed from powder photographs. A novel feature of the work is the use made of the relative intensities of the X-ray reflections to estimate the proportions of the constituents in two- and three-phase alloys. The single-phase fields are derived from the Cu-Al and Ni-Al systems, with the exception of τ (Cu_3NiAl_4), which has a new type of structure, derived from a deformed body-centred cube.

AUTHORS.

3911. Lattice Constants of Non-Cubic Substances (Bi, Mg, Sn) by the Asymmetric Method. A. Ievins, M. Straumanis and K. Karlsons. *Zeits. f. phys. Chem.* 40, Abt. B. 5. pp. 347-356, 1938.—In order to test the applicability of the asymmetric method of taking Debye-Scherrer X-ray photographs the lattice parameters of Bi, Mg, and Sn are measured. The following values are obtained:—

Bi— $a=4.53674 \pm 0.00004$, $c=11.83834 \pm 0.00004$, $c/a=2.60944$;

Mg— $a=3.20280 \pm 0.00003$, $c=5.19983 \pm 0.00005$, $c/a=1.62353$;

Sn— $a=5.81970 \pm 0.00002$, $c=3.17488 \pm 0.00005$, $c/a=0.54554$.

These results are in good agreement with those of other authors, but it is claimed that they have a higher precision, viz., 0.001%.

J. I.

3912. Structure of Co_2Al_3 . A. J. Bradley and C. S. Cheng. *Zeits. f. Krist.* 99. 6. pp. 480-487, 1938. *In English.*— Co_2Al_3 is hexagonal with $a=7.656$, $c=7.593$ Å and $4Co_2Al_3$ in the unit cell, space group D_4^2-C6/mmc . The 28 atoms are arranged in or near four equidistant planes, 7 in each, perpendicular to the hexagonal axis. Atomic distances and diagrams showing relative positions are given.

C. A. S.

3913. Structure of KHF_2 . V. Caglioti and G. Giacomello. *Ricerca Scientifica*, 9. pp. 545-549, June, 1938.—The unit cell of KHF_2 is tetragonal, $a = b = 7.98$, $c = 6.74$ Å, and contains 8 molecules. The most probable space group is D_4 . From intensity measurements a Patterson analysis is made, and diagrams are given to show the positions of the atoms in the cell. The distance K-F is found to be 2.65 Å.

C. J. B. C.

3914. Structure of $\text{Cs}_2\text{AuAuCl}_6$ and $\text{Cs}_2\text{AgAuCl}_6$. N. Elliott and L. Pauling. *Am. Chem. Soc., J.* 60. pp. 1846-1851, Aug., 1938.

3915. Ice. W. H. Bragg. *Roy. Inst., Proc.* 30. 2. pp. 283-301, 1938.—The structure of ice as determined by X-rays is described and connected with its plastic and elastic behaviour, and shown (with its peculiar maximum density law) to account for the motion of glaciers. Formation of slip planes is explained; and absence of cold-working effect in ice attributed to non-formation of small crystals on such working. The behaviour of single crystals of Cu is contrasted. Sublimation and condensation and formation of snow flakes is described, and lastly the differences between the structures of Ices I, II and III are explained.

C. A. S.

3916. Comparison of Rotated-Crystal and Powder Methods. M. Straumanis and A. Ievins. *Zeits. f. Physik*, 109. 11-12. pp. 728-743, 1938.—The authors have applied their method for the accurate determination of lattice constants to the method of rotated single crystals. A comparison of the results of both methods for rock-salt shows that both methods are equally applicable. The data are for rock-salt: lattice constant of powdered rock-salt 5.62747 ± 0.0003 Å and of single crystals 5.62735 ± 0.00002 Å at 18°C . The difference in the two values can be explained by absorption in the single crystals and by the heating of the powder. Experiments with $\text{Co}[\text{Hg}(\text{CNS})_4]$ showed that the lattice constants of different crystals differed from each other by 0.008 Å. In this case the two methods furnish the same results only if the powder and the crystals have exactly the same chemical composition. The lattice constants of $\text{Co}[\text{Hg}(\text{CNS})_4]$ are: $a_{25} = 11.08944 - 11.09756$ Å, $c_{25} = 4.36465 - 4.36524$ Å, $\alpha^\perp = -10.85 \times 10^{-6}$, $\alpha_\parallel = +149.3 \times 10^{-6}$.

L. K.

3917. Infra-Red Study of Liquid Crystals. R. Taschek and D. Williams. *J. Chem. Phys.* 6. pp. 546-552, Sept., 1938.—The near infra-red spectra of three liquid crystals have been studied in the isotropic and anisotropic phases, and several band shifts have been observed. A detailed study of the transmission as a function of temperature was made at various wave-lengths. Pronounced changes in transmission were observed at melting and clearing points, the magnitude of the changes being greater at short wave-lengths. Rapid variations in transmission occurred in the mesophase. A qualitative explanation of the observed changes is given in terms of Ornstein's theory of scattering. The application of infra-red methods to the study of changes of state is discussed.

AUTHORS.

3918. Etch Figures of Quartz. W. L. Bond. *Zeits. f. Krist.* 99. 6. pp. 488-498, 1938. *In English*.—A hollow section of right-handed quartz, slightly less than a hemisphere, was polished inside, and ground smooth and spherical outside. The spherical surface was etched for 1 hr. with aqueous HF (the interior being protected with paraffin). Microphotographs ($\times 70$) of all the 36 varieties of etch figure were taken

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and are reproduced. The orientation of the area over which each extends is noted on a stereographic projection. C. A. S.

See also Abstracts 4064, 4113, 4155, 4156, 4239, 4243, 4245.

DENSITY.

See Abstracts 3981, 3983.

DIFFUSION AND OSMOSIS

3919. Process of Diffusion in a Centrifugal Field of Force.

Part II. W. J. Archibald. *Phys. Rev.* 54. pp. 371-374, Sept. 1, 1938.—The general equation for the settling of particles and molecules in a liquid suspension or ideal solution has been solved for the case of a cell with radial sides and two bounding cylindrical ends. A set of curves is given which shows the concentration at all points in the cell for different values of the time. [For Part I see Abstract 2254 (1938).] AUTHOR.

3920. Diffusion of Electrolytes in Solution. K. Sitte and V. Daniel. *Zeits. f. phys. Chem.* 182. *Abt. A.* 4. pp. 295-318, 1938.—Diffusion processes in solutions of electrolytes (LiCl, LiBr, NaCl, NaBr, NaI, KCl, KBr, KI) in H_2O have been studied. The diffusion of these electrolytes can be represented by a differential equation of the Boltzmann type. Two methods of calculating the diffusion coefficient are given. For very small concentrations the coefficient decreases with concentration according to a square root law as required by the Debye-Hückel theory, but even at concentrations of about 0.05 *M* the value was considerably greater than the theoretical for all the substances investigated, and increases further with increasing concentration. This may be explained as due to ionic association of the type assumed by Bjerrum, and the interaction of ions with the H_2O dipoles according to Born's theory. Investigations with solutions of LiCl in CH_3OH and C_2H_5OH and of NaI in C_2H_5OH gave higher values for the diffusion coefficient than the theoretical. These deviations may be explained in the same way as for aqueous solutions. The migration of ions of strong electrolytes in H_2O , CH_3OH , and C_2H_5OH can be completely explained by the interior forces and the interaction between the charged ions and the dipoles of the solvent. It is unnecessary to assume any special forces for aqueous or alcoholic solutions. A. J. M.

3921. Variation of Osmotic Pressure, Heat of Dilution and Dilution Entropy of High-Molecular Solutions with Temperature. G. V. Schulz. *Zeits. f. phys. Chem.* 40. *Abt. B.* 5. pp. 319-325, 1938.—Two equations are available for the calculation of heat of dilution from the variation of osmotic pressure with temperature according as whether the composition of the solution or its volume remains constant. An exact relationship is derived for the second case. The heat of dilution previously calculated from the variation of osmotic pressure of solutions of nitrocellulose in acetone and polystyrene in toluene with the aid of the Helmholtz equation are about 30% too low. The dilution entropy is found to be identical in value with the mixing entropy. Hence deviations of the osmotic pressure from the values given by the van't Hoff equation are due only to forces between the molecules of the solute and the solvent. A. J. M.

See also Abstract 3969.

ELASTICITY AND PLASTICITY.

3922. Elastic Constants of Transparent Isotropic Solids.

K. H. Hoesch. *Zeits. f. Physik*, 109, 9-10, pp. 606-624, 1938.—Super-sonic vibrations, both longitudinal and transversal, are produced by an oscillating quartz crystal in the solid (usually glass) and are made visible by the refraction and polarisation which they produce. Their wave-length can be measured under the microscope and in this way the elastic constants can be determined within about 1% error. R. P.

3923. Temperature Dependence of Tension in Rubber. V.

Hauk and W. Neumann. *Zeits. f. phys. Chem.* 182, Abt. A. 4, pp. 285-294, 1938.—Apparatus is described for determining the variation of the tension in rubber with temperature, the extension remaining constant. Three types of vulcanised rubber were used, and for all three the decrease of tension was proportional to the absolute temperature. The tension coefficient for the greater extensions is dependent on the extent of vulcanisation, increasing with the S content of the rubber. The results are discussed and an explanation is offered. A. J. M.

3924. Subpermanent Deformations. J. Gallbourg and P.

Laurent. *Comptes Rendus*, 207, pp. 34-35, July 4, 1938.—A number of further results upon the subpermanent deformation of plexigum are given. W. G. B.

3925. Vibration of a Bar Bent along a Circular Arc. T. Ikebe.

Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 796, pp. 680-712, July, 1938. *In English*.—The frequency of the fundamental mode of a circular ring with a small gap vibrating in its plane is calculated by the Rayleigh-Ritz method. Experimental results differed from the calculated one by about 1%, so the value was redetermined from the differential equations, which showed the original theoretical result to be accurate to four figures, and this is confirmed by applying the Rayleigh-Ritz method to an almost straight bar. The rotational energy is too small to explain the discrepancy, which is finally attributed to the difference between dynamical and statical values of Young's modulus. W. G. B.

3926. Rupture. P. W. Bridgman. *J. of Applied Physics*, 9,

pp. 517-528, Aug., 1938.—Rupture must be considered as essentially a problem in stability, and one would not expect any general criterion of rupture in terms of ordinary large-scale stress and strain. Changes in atomic positions leading to instability may be of various types, but the discussion is mainly confined to cases in which unusually large extensions in particular directions occur. In this way rupture which occurs on the release of pressure or against the stress, such as in the case of a glass rod subjected over a portion of its length to high pressure over its curved surface, and which shows a characteristic "tensile" rupture, and others, are explicable. W. G. B.

See also Abstracts 3948, 4180, 4184.

GRAVITATION.

3927. Rapid Measurement of Relative Value of g . G. Bertrand.

Comptes Rendus, 207, pp. 356-357, Aug. 8, 1938.—A weight Mg is supported by a vertical wire of ferromagnetic material, e.g., invar, which vibrates with fundamental frequency, F , between the poles of a horseshoe magnet, around which a bobbin is wound; F is deduced from the frequency of the current therein induced with an accuracy of $1/10^4$. Variations in g

are deduced from the equation $2F = L\sqrt{Mg/\mu}$. The arrangement is standardised by varying M . Necessary precautions and corrections are described. C. A. S.

3928. Graphical Enumeration of Results in Gravimetry. F. Breyer. *Beitr. z. angew. Geophys.* 7, 3, pp. 317-336, 1938.—Various methods of deducing results as to gradient and curvature values, gravity, deviation of the plumb-line and potential are discussed and the results compared. The various corrections necessary are reviewed. C. A. S.

See also Abstracts 4017, 4022, 4023, 4024.

HYDRODYNAMICS AND AERODYNAMICS.

3929. Influence of Vortices upon the Resistance of a Circular Cylinder Moving through a Fluid. S. Tomotika and N. Sugawara. *Phys. Math. Soc. Japan, Proc.* 20, pp. 467-477, June, 1938. *In English*.—The drag due to two symmetrically disposed line vortices in the wake of the cylinder is worked out both by integrating the pressure, and by use of the momentum theorem. The two results agree with one another, and confirm Bickley's result [see Abstract 2050 (1928)]. W. G. B.

3930. Pressure Dependent upon Vortex Formation. A. Donoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19, 5, pp. 365-368, 1938. *In English*.—The two-dimensional flow of an ideal thermally non-conducting gas past a smooth rigid obstacle arranged so that a sudden increase of density of the gas is produced in front of the obstacle is investigated mathematically for the case in which the non-disturbed velocity of the stream is parallel to the axis of abscissae and exceeds the velocity of sound. J. S. G. T.

3931. Conical Motion of Ideal Gas in the Case of a Sudden Increase of its Density (Boosemann's Problem). V. Boolinsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19, 5, pp. 369-371, 1938. *In English*.—The general case corresponding to the motion of an ideal thermally non-conducting gas flowing with a velocity exceeding that of sound past a cone having as directrix a special kind of curve corresponding to the cross-section of a thin aerofoil with a sharp leading edge is discussed mathematically. J. S. G. T.

3932. Chambers for Reducing Pressure Oscillations in Pipes. I. Tcharnyi. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19, 6-7, pp. 453-458, 1938. *In English*.—A method of calculating the capacity of chambers to be inserted in pipe-lines for reducing pressure surges, taking into account both viscosity and compressibility of the fluid is discussed. Impulsive (hammer) and periodic surges are considered. J. S. G. T.

3933. Secondary Flow in Straight Pipes. L. Howarth. *Cambridge Phil. Soc., Proc.* 34, pp. 335-344, July, 1938.—By the application of the modified vorticity transfer theory, with Goldstein's assumption as to the tensor L_{ij} , it is shown that the condition for secondary flow is that the mixture length is not constant along curves along which $|\text{grad } u|$ is constant, u being the velocity parallel to the pipe axis. Although an investigation of the form of the secondary flow is deferred until further information as to the values of certain constants in the tensor becomes available, the general form of the stream function indicates that reasonable results are to be expected. W. G. B.

3934. Fluid Movements Giving a Succession of Applicable Surfaces. H. Pailloux. *Comptes Rendus*, 207. pp. 319-321, Aug. 1, and pp. 389-390, Aug. 17, 1938.

3935. Dispersion of a Turbulent Air Current and the Flow of Underground Water. K. Kitagawa. *Comptes Rendus*, 207. pp. 353-356, Aug. 8, 1938.—Luntz and Japy [see Abstract 2281 (1936)] have shown that the coefficient of turbulence of an air stream can be determined from a single temperature measurement made in the wake of a heated wire placed in the stream. The author shows that a very similar mathematical analysis can be applied to the dispersion of underground water by the sub-soil. R. W. P.

3936. Structural Mechanics of Viscous Elastic Continua. Part II. H. Umstätter. *Kolloid Zeits.* 84. pp. 168-179, Aug., 1938.—Continuing previous work [see Abstract 3015 (1936)], a wave-mechanical theorem of turbulence is derived. It is shown that in consequence of the finite propagation velocity of the tangential disturbances, the separate layers of a spatially extended continuum are effected by the disturbance in a temporary series. In consequence the valid classical relaxation equation must be referred back to such a time-point as the layer in question in removed from the focus of the disturbance. Every lamella has therefore its own time-calculus. In order to obtain a computation of time independent of the system of reference recourse is made to a Lorenz-transformation, and by this relativistic invariant treatment of the Maxwell equation it has been found possible to calculate the distribution of velocity in a spatially extended differential part and to integrate the Newtonian definition equation. The expression thereby obtained affords the theoretical explanation of structural viscosity and anomalous turbulence experimentally determined by Wo. Ostwald. H. H. Ho.

3937. New Method for the Measurement of Gas Flow. R. Duchêne. *Comptes Rendus*, 207. pp. 35-37, July 4, 1938.—The method consists of injecting at one point A of a conduit a small quantity of a gas of a different refractive index, and detecting its arrival at a point B some distance downstream by means of an interferometer. The discharge is determined from the time taken, the length AB, and the sectional area of the conduit. Experiments in a large gas works have shown good agreement with other methods, when applied to a conduit of diameter 1 m. W. G. B.

***3938. Sensitivity of Immersed Venturi-Pitot Head at Low Speeds.** C. Salter. *Phil. Mag.* 26. pp. 272-289, Aug., 1938.—This paper deals with experiments designed to improve the sensitivity of a small-size venturi combined with a total head tube, and to discover whether such an instrument would prove satisfactory as a standard low-speed anemometer. The overall size of the venturi used was not more than about 1 in. in maximum dia. and about 4 in. in length, and the wind speeds were confined to the range 0-10 ft./sec. Full instrumental details are included with 12 appropriate diagrams, and while the experimental data should be useful in other directions, the conclusion was drawn that this particular instrument was not really suitable for use as an accurate standard low-speed anemometer. H. H. Ho.

See also Abstract 4035.

KINETIC THEORY OF MATTER.

3939. Vibration of Molecules in Liquids and its Relation to Viscosity. D. B. MacLeod. *Phys. Soc., Proc.* 50. pp. 788-800, Sept. 1, 1938.—An expression is found for the variation, with temperature, of the average frequency of vibration of a molecule in a liquid. The absolute frequency is calculated approximately and is used in Andrade's expression for the viscosity of a liquid at the melting point, namely, $\eta = 1.7m/\sigma$, to obtain an expression for the variation of viscosity with temperature. The absolute value of the viscosity is calculated approximately. The internal pressures of several monatomic liquids have been calculated. AUTHOR.

3940. Velocity Distribution in an Atomic Stream and the Free Wave-Length as a Function of Velocity. N. Sasaki and M. Fukuda. *Imp. Acad. Tokyo, Proc.* 14. pp. 166-169, May, 1938. In German.—The results are given of an experimental test of the Maxwellian law of velocity distribution and the Tait formula for the free wave-length as a function of the velocity. An atomic stream of Na was formed and the velocity spectrum obtained with a non-homogeneous magnetic field. The intensity distribution was measured with a movable heated tungsten electrometer wire. The results are shown in a diagram. The maximum of the velocity spectrum is almost equally spaced on the two sides of the stream and a secondary maximum due to unmagnetised Na_2 molecules is shown. The theory of the method is given and theoretical and experimental results agree well as shown in a table. R. S. R.

LENGTH, AREA AND VOLUME.

***3941. Radii of Curvature.** K. Glesebart. *A.T.M.* No. 85. V44-6, July, 1938.—An account of the methods of determining radii of curvature, chiefly of lenses, by calculation and by direct and indirect measurement. P. H. B.

3942. Method of Ascertaining and Defining Fineness of Powder. I. Iitaka and R. Shlota. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 811. pp. 897-904, Aug., 1938. In English.—The relationship between m the mesh number and d the distance in inches between two adjacent wires in a series of standard sieves is found to be given by the expression $md = 0.579$. This relation may be extended into a finer range of imaginary sieves and the fineness of any powder may be defined by a mesh number calculated from this equation. To determine the fineness of a powder which cannot be separated by actual sieves, a micro-photograph of the powder is compared with networks of imaginary sieves, the dimensions of which are calculated from the above equation, at a magnification of 100 dia. W. H. Wal.

***3943. Photoelectric Methods of Metrology.** L. Queyron. *R.G.E.* 44. pp. 265-268, Sept. 3, 1938.—Describes apparatus for the precise measurement of length to, say, 0.1μ by making use of a knife-edge moving across a fine slit through which a beam of light falls on a photo-cell. Other types of measurement, such as angular displacement, diameter of fine wires, evaluation of areas, etc., are dealt with in the later sections of the paper. J. W. T. W.

MASS.

***3944. Electronic Recording Analytical Balance.** R. H. Muller and R. L. Garman. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 436-440, Aug. 15, 1938.—An electronic recording analytical balance

is described which is direct-reading, rapid and sensitive. All mechanical or electrical contactors, relays and the like are dispensed with, inertia- and lag-free electronic methods being employed instead. The time axis is linear and accuracy is assured, as the recorder is driven by a synchronous motor. A choice of speeds is available. The sensitivity is adjustable, so that one division on the record may be set exactly to either 10, 1 or 0.1 mg. This is an electrical adjustment and necessitates no mechanical adjustment of the balance proper. The overall sensitivity is from 20 to 50 times greater than the normal sensitivity of the balance proper, owing to the very precise photoelectric scanning of the pointer, 0.4 mm. displacement of the latter being sufficient to energise the compensating motor. Remote indication and automatic control are inherent features. The instrument utilises standard components, e.g., a magnetically damped chainomatic balance, a recording potentiometer and readily available electronic parts. It should prove of general utility in all investigations involving very slow or very rapid changes of weight or in the study of phenomena which can be followed indirectly by a change of weight. A. W.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3945. Fundamental Theorem of the Calculus. K. Yosida. *Imp. Acad. Tokyo, Proc.* 14. pp. 211-213, June, 1938. In English.—The construction of all matrix groups continuously homomorphic to the universal covering group G of a connected semi-simple Lie group G with s parameters is achieved by the theory of almost periodic functions.

G. C. McV.

3946. Anomalous Case in Cauchy's Problem for the Wave Equation. E. Frola. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 412-427, April-June, 1938.—A function is supposed to be regular and satisfy the wave equation at all times and for a region of space bounded by two parallel planes (or, as a limiting case, in a half-space). Its values for one of the bounding planes and its normal derivative are supposed to be given. It is then proved that, if the function with these properties exist, it is uniquely determined. It does exist, provided the boundary values satisfy certain simple requirements.

R. P.

3947. Operational Solution of the Wave Equation. L. A. Pipes. *Phil. Mag.* 26. pp. 333-340, Sept., 1938.

3948. Wave-Motion for Infinite Domains. A. N. Lowan. *Phil. Mag.* 26. pp. 340-360, Sept., 1938.

3949. Riemannian Tensors. V. V. Narlikar. *Phil. Mag.* 26. pp. 390-394, Sept., 1938.—It is shown how non-null tensors can be represented by vectors with reference to an orthogonal system of basic tensors called R-tensors. The transformation of vectors is discussed and some new inequalities are deduced from the vector representation. AUTHOR.

3950. Operational Forms and Contour Integrals for Bessel Functions with Argument $a\sqrt{t^2-b^2}$ N. W. McLachlan. *Phil. Mag.* 26. pp. 394-408, Sept., 1938.

3951. Generalised Fractional Integration and Differentiation. W. Fabian. *Phil. Mag.* 26. pp. 408-410, Sept., 1938.

3952. Complete Solution of Differential Equation for Confluent Hypergeometric Function. W. J. Archibald. *Phil. Mag.* 26. pp. 415-419, Sept., 1938.

3953. Centres and Foci. I. Koukies. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 450-464, 1938. *In French.*—The object of this paper is to study the singular points of the phase plan for the equation: $dy/dx = -F(x, y)/y$ (F being an analytical function), and for the cases where these points are centres or foci. A new method is therefore derived for distinguishing a centre from a focus, which is more effective and useful than the former processes of Bendixon and Frommer, and which allows in certain cases of the existence of a centre to be established by means of a finite number of operations. The paper is entirely mathematical. H. H. Ho.

3954. Comparison of Series of Measures on Different Hypotheses Concerning the Standard Errors. H. Jeffreys. *Roy. Soc., Proc.* 187A. pp. 367-384, Sept. 8, 1938.—A test previously given [see Abstract 1047 (1937)] for the significance of the difference of two means, when the standard errors are unequal, is revised to take account of the uncertainties of the standard errors and of a theoretical complication that has given trouble in other tests. The case where the standard errors can be assumed equal is derived from an existing formula. Some incidental points are discussed and a list is given of tests that have been revised in later work. AUTHOR.

3955. Posterior Probability Distributions of the Ordinary and Intra-Class Correlation Coefficients. H. Jeffreys. *Roy. Soc., Proc.* 187A. pp. 464-483, Sept. 23, 1938.—The posterior probabilities of the ordinary and intra-class correlation coefficients are obtained from an analogy with sampling theory, suggested by the applicability of the normal correlation surface in both cases. The results cast some further light on the relation between direct and inverse methods in problems of estimation; for practical purposes the recommendations made would not differ appreciably. A significance test is obtained for the difference between an intraclass correlation coefficient and zero, and the application to internal correlation in series of measurements is discussed. AUTHOR.

3956. Dimensionless Constants of Physics. A. E. Haas. *Nat. Acad. Sci., Proc.* 24. pp. 274-276, July, 1938.—In addition to four previously-known dimensionless constants a fifth should be introduced, namely the ratio of the total number of neutrons to the total number of protons in the universe. By generalising a formula of Sitte and Glaser [see Abstract 1485 (1934)], it is concluded that in a state of equilibrium the number of neutrons nearly equals the number of protons. They would be exactly equal if the empirical value of $(m_p/m) \times e^2/hc$ were diminished by 0.5% (m_p = mass of proton, m = mass of electron). K. M. C.

See also Abstracts 3963, 4189.

MECHANICS, CLASSICAL.

See Abstract 4036.

MECHANICS, QUANTUM.

3957. Dirac Electron Theory. E. L. Hill and R. Landshoff. *Rev. Modern Physics*, 10. pp. 87-132, April, 1938.—A comprehensive review of the principal properties of the Dirac equation and of its solutions. Starting from the electron spin hypothesis a detailed treatment is given of the non-relativistic theory of Pauli, developed so as to bring out the transition from the Schrödinger to the Dirac equations, and given in a form which is a compromise between the treatment of Pauli and Darwin.

The Dirac relativistic wave equation, with its solutions, applications, and development is then presented. The physical interpretation of the theory, the Dirac positron theory, and the extension of the Dirac equation to two particles are also reviewed. Subsidiary mathematical aspects and methods are given in a series of appendices. N. M. B.

3958. Static Interaction of Charged Particles. C. D. Thomas. *Phys. Rev.* 54, pp. 367-370, Sept. 1, 1938.—The energy of the field due to two charges as described by the field equations of the unquantised Born-Infeld theory is calculated to the first approximation in the case of stationary charges not subject to other external fields. The method of representing the field as the superposition of plane waves in a very large cavity is applied to the field equations expanded in a power series in the constant $1/b^2$ of the Born theory. For the first term this leads to the usual Coulomb energy. The process is then extended to calculate the second term from insertion of the coefficients arising in the first term evaluation. In this case it is found necessary to perform threefold averages in place of the previous single averages, since three of the radiation oscillators describing the field enter into combination. The resulting energy is $e_1 e_2 / r [1 - (1/b^2)(e_1^2 + e_2^2)/8r^4]$. The nature of the series expansion makes the method invalid in the region near 10^{-13} cm. since there the series becomes divergent. AUTHOR.

3959. Spin Phenomena and Boundary Conditions. F. Möglicher. *Zeits. f. Physik*, 110, 1-2, pp. 1-7, 1938.—It is shown that by changing the boundary conditions the directional quantisation of an electron with spin can be described without making use of the Dirac or Pauli matrices. The H problem calculated in this way gives a fine structure formula with integral azimuthal and half integral radial quantum numbers but with the correct multiplicity of eigenfunctions. If certain invariant terms are introduced into the relativistic Gordon wave equation a new wave equation is obtained which for the changed boundary conditions gives the same result as the Dirac equation of the electron. J. E. K.

3960. Final Multiplier and its Validity in Quantum Mechanics. R. Dugas. *J. de Physique et le Radium*, 9, pp. 287-290, July, 1938.—Starting from the interpretation of the final multiplier [see Abstract 1962 (1937)] as a probability density, its expression in wave mechanics and Dirac mechanics is given, defining the corresponding differential systems which play a direct part in the statistical coordination of the old and new mechanics. It is shown that, assuming Planck's law and preserving the Newtonian definition of the state of a system, a discontinuous final multiplier results. The new quantum mechanical definition of state allows the final multiplier to be regularised. N. M. B.

3961. Influence of Radiation on Ionisation Equilibrium. B. N. Srivastava. *Roy. Soc., Proc.* 167A, pp. 484-499, Sept. 23, 1938.—The generalised ionisation formula in the case of thermodynamical equilibrium for an assembly consisting of atoms, ions, electrons and radiation is derived, the particles being supposed to obey any statistics. The ionisation produced in matter has been found for the case when the reaction space is traversed by radiation at a higher temperature. The electrons have been assumed to obey Fermi-Dirac statistics, while the atom and the ion are taken to obey Boltzmann (classical) statistics. The general ionisation formula for this case is derived and two limiting cases discussed. The Woltjer-Milne formula for ionisation in any radiation field is readily obtained as a special case of the general formula. The ionisation formula

for the case when the electrons behave as a degenerate gas is also deduced from the general formula. On substituting the usual expression for the probability of ionisation, *viz.*, $\psi = Cv^{-2}$, it is found that the ionisation becomes much less when the electrons are highly degenerate. AUTHOR.

3962. Effusion Phenomena in Relativistic Quantum Statistics.

B. N. Srivastava. *Roy. Soc., Proc.* 167A. pp. 516-526, Sept. 23, 1938.—

The effusion phenomena in non-degenerate and degenerate matter are investigated from relativistic mechanics. Matter obeying either Fermi-Dirac statistics or Bose-Einstein statistics is considered. Non-degenerate matter is first considered, and the number of particles as well as the mass of matter effusing out is calculated. The non-relativistic expressions are obtained as a limiting case. For $f = 10$ the departure from the value for a classical perfect gas amounts only to about 1%. The effusion is then calculated for a degenerate gas, degenerate in the sense of Fermi-Dirac statistics, both to a first approximation and to a second approximation. The non-relativistic formulæ are obtained as a limiting case. In this case it is found that to a first approximation the effusion varies as $p^{\frac{1}{2}}$ and is independent of T , but on working to a second approximation a slight dependence on temperature is observed. The average mass of particles in the effusion stream is calculated. AUTHOR.

See also Abstracts 3883, 3946, 3947, 3948, 4123, 4170, 4216.

PHILOSOPHY OF SCIENTIFIC METHOD.

3963. Logic and Probability in Physics. **C. G. Darwin.** *Nature*,

142. pp. 381-384, Aug. 27, 1938. *Science*, 88. pp. 155-160, Aug. 19,

1938. *From the Presidential Address to the British Assoc. (Sect. A), Cambridge, Aug., 1938.*—Recent scientific history has revealed a deep

schism between professional philosophers and scientists. General philosophy has played no part in the great revolutions of thought of the present century. Each scientist has made some sort of metaphysics for himself. The old logic was devised for a world which was thought to have hard outlines; the method of reasoning must be changed now that the new mechanics has shown that the outlines are not hard. There must exist a wider system of logic having probability as one of its features. The existence of chance is regarded as a blemish; we start prejudiced against probability and in favour of causality. Many are still trying to bring probability within the fold of the old logic; the author does not believe it can be done. The greatest contribution to the subject of probability (in connection with the theory of gases) was made by Gibbs, who made a big assumption quite frankly and without attempt at justification. The subject of probability should play an enormous part in our mathematical-physical education; the study of probability must be incorporated in other subjects. J. S. G. T.

See also Abstract 4154.

PRESSURE.

See Abstract 3938, and

2852B. Energy Content of Gases at High Pressures. **E. W. Geyer.**

RELATIVITY AND ETHER.

3964. Light Signals Sent Around a Closed Path. **H. E. Ives.**

J.O.S.A. 28. pp. 296-299, Aug., 1938.—In the Sagnac experiment two simultaneously emitted light signals are sent in opposite directions around

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a closed optical path, the whole optical system being in rotation about an axis perpendicular to the plane of the apparatus. The results were interpreted as positive evidence for the existence of the ether. The author discusses the modified form of the experiment as performed by Dufour and Prunier [see Abstract 4005 (1937)]. He concludes, in spite of arguments to the contrary [see Abstract 5301 (1937)] that Sagnac's contention remains valid. No consideration of rotation relative to material surroundings is involved; if, and only if, the apparatus rotates with respect to the stars, the observer on the apparatus will observe a Sagnac effect.

See also Abstract 4153.

SOLUTION.

3965. Distribution of RaD(Pb) between Crystals and Solutions of $\text{Ba}(\text{IO}_3)_2$. A. Polessitsky. *Acta Physicochimica*, 8. 6. pp. 864-868, 1938. In English.—The distribution of RaD between the crystals and solutions of $\text{Ba}(\text{IO}_3)_2$ at different temperatures is studied. It is shown that $\Delta\mu$ in accord with Ratner's theory does not vary with temperature [see Abstract 5376 (1933)]. The distribution of RaD between the crystals of $\text{Ba}(\text{IO}_3)_2$ and their solutions containing different quantities of $\text{Ca}(\text{NO}_3)_2$ is also studied. It is shown that the variation of the partition factor D with the ionic strength of the solution agrees with Ratner's theory. The calculated values of the "true partition factor" D_0 are nearly constant.

AUTHOR.

3966. OsO_4 in CCl_4 Solutions. L. H. Anderson and D. M. Yost. *Am. Chem. Soc., J.* 60. pp. 1822-1825, Aug., 1938.—The distribution ratios of OsO_4 between CCl_4 and water have been measured at 25° for the whole range of concentrations up to saturation and found to vary from $R = N$ (in CCl_4)/ N (in H_2O) = 78 to $R = 136$. The results of solubility measurements are in agreement with the ratio at high concentrations. The vapour pressures of dry CCl_4 above its solutions of OsO_4 were measured at 25° and over the range of concentrations up to saturation. The results do not accord with Raoult's equation. Electron diffraction, spectroscopic and thermal data are used to evaluate the free energies of gaseous, solid and aqueous OsO_4 .

AUTHORS.

See also Abstracts 3969, 4140, 4216, 4217.

SURFACE PROPERTIES.

3967. Mechanism of the Adsorption Process. Part I. A New Theory of Adsorption. B. M. Gouguell and E. Ruderman. *Acta Physicochimica*, 8. 6. pp. 795-810, 1938. In English.—A new theory of adsorption is proposed, based upon the experimental evidence of fast adsorption with the same high binding energy at low and high temperatures (observed by Roberts) upon the flow of gas through small capillaries, the experimental data and theory of which were given by Clausius, and upon a new "pseudo-desorption" effect observed by the authors. From this theory it follows that the so-called van der Waals' adsorption is a combination of adsorption with high binding energy and condensation, the adsorbed gas forming several layers and the number of these layers varying with the temperature and pressure. This conception of polymolecular layers is in accord with the work of Bradley. Experimental evidence for the "pseudo-desorption" effect is presented together with a description of apparatus and procedure. From the results of preliminary experiments

it follows that the rate of adsorption is actually the rate at which the gas fills up the inner cracks and spaces existing in the particles of the adsorbent.

AUTHORS.

3968. Retention of Vapours by Active Gels. F. Krczil, F. Schätzler and E. Brixel. *Kolloid Zeits.* 84. pp. 144-149, Aug., 1938.—The amount of benzene retained by a silicic acid and an alumina gel after adsorption and removal of the vapour by blowing air over the gel was determined. In the case of both gels the amount of vapour ultimately retained is independent of the initial amount present, in agreement with the results for activated charcoal.

A. J. M.

3969. Gases and Metals. C. J. Smithells. *Roy. Soc. Arts, J.* 86. pp. 936-949, Aug. 5; 951-964, Aug. 12, and pp. 971-983, Aug. 10, 1938.—The author discusses the behaviour of gases and metals in contact under various conditions, and the laws controlling this behaviour. The subjects discussed comprise, (1) adsorption of gases on metal surfaces, (2) diffusion of gases through solid metals, and (3) solution of gases in metals.

J. S. G. T.

3970. Rate of Adsorption of Gases by Porous Materials. E. Wicke. *Zeits. f. Elektrochem.* 44. pp. 587-590; *Disc.*, 590, Sept., 1938.—An expression for the rates of adsorption and desorption on porous materials is developed, on the assumption that the material possesses a structure consisting of macro-pores of the order of 10^{-4} cm. in size, the walls of which contain micro-pores of the order of 10^{-7} cm. The rate of adsorption of CO_2 at 0°C . and 1 mm. pressure by various samples of active charcoal and of silica gel was investigated. Results obtained for two samples of charcoal support the theory, and lead to a value for the effective diffusion coefficient which agrees well with that obtained directly from measurements of the rate of flow of CO_2 through single granules of the material. In the case of silica gel, and of a third sample of charcoal, active adsorption caused a deviation from the theoretical value. With certain exceptions, the author concludes that the theory is of general validity in so far as purely physical adsorption is concerned.

W. H. Wal.

3971. Adsorption of O_2 by Molten Ag. T. Gerassimoff. *Zeits. f. Elektrochem.* 44. pp. 709-716, Sept., 1938.—Measurements, made by the maximum bubble pressure (Jaeger's) method, of the surface tension of molten Ag in an atmosphere of O_2 show that the dissolved O_2 is capillary-active and is adsorbed by the Ag surface in atomic form. The heat of adsorption is calculated to be 5.2 kg. cal. per $\frac{1}{2}$ mol. O_2 , and agrees approximately with the heat of formation of Ag_2O , 6.7 kg. cal. This can be regarded as evidence that the adsorption of O_2 by the Ag surface is actually a chemical combination.

W. H. Wal.

3972. Adsorption of N_2 and O_2 on W. A. B. van Cleave. *Faraday Soc., Trans.* 34. pp. 1174-1177, Sept., 1938.—The accommodation coefficient of Ne has been used as an indicator to study the adsorption of N_2 and of O_2 on bare W. The rapid adsorption of N_2 at room-temperature observed earlier by a different method has been confirmed and some properties of the second O_2 film, which is formed in addition to the well-known stable film, have been investigated.

AUTHOR.

3973. Sorption of Polar and Non-Polar Gases by Zeolites. R. M. Barrer. *Roy. Soc., Proc.* 167A. pp. 392-420, Sept. 6, 1938.—The sorption equilibria of NH_3 on five zeolites have been studied. The zeolites give sometimes ammoniates and sometimes simple sorption systems, as well as intermediate systems. When dehydration causes

changes in the lattice, ammoniates tend to form: more rigid anionic frameworks of Si-O-Al give sorption systems (chabasite, analcite). The magnitude of the sorption heat bears no relation to the formation of ammoniates. The sorption kinetics of NH_3 by zeolites reveal two types of gas uptake: by diffusion of NH_3 down concentration gradients within the solid; and by diffusion of the phase-boundaries in an ammoniate-dehydrated zeolite. Sorption was rapid for chabasite and analcite (with rigid frameworks) and slow for fibrous and platy zeolites. The thermal treatment in dehydrating the zeolite had a marked influence on the sorption rates in heulandite. The heats of sorption of NH_3 in analcite and chabasite, and on the external surface of natrolite, diminished as the charge of gas increased. The initial values were 30, 23.5, and 12.4 kg.cal. respectively; but the sorption heats decreased somewhat as the temperature was raised. The heat of ammoniate formation in natrolite was 11.7 kg.cal., independent of the amount of ammonia taken up, within limits, and only slightly dependent upon the temperature. The amounts of NH_3 sorbed at saturation approached the theoretical maximum for chabasite and natrolite but were only one-third of this maximum for analcite and heulandite. The saturation maxima decreased linearly with increasing temperature. AUTHOR.

3974. Primary and Secondary Adsorption of Metallic Ions at Metal Surfaces. O. Erbacher. *Zeits. f. phys. Chem.* 182, Abt. A. 4, pp. 243-255, 1938.—In continuation of the work of v. Euler who studied the adsorption of Ag at a smooth Au surface in dilute AgNO_3 solution [see Abstract 981 (1923)], the author has investigated the adsorption of Pb at a surface of Ag, Ni or Au, at 20° C. and 70° C., in 0.1 N solution of HCl, using the radioactive isotope ThB as an indicator of the distribution of the Pb between the solution and surface. Metal kations are primarily adsorbed and carry an equivalent mass of ions along with them. The adsorbed mass is found to be independent of temperature only when the concentration of the non-noble metal (Pb) in the solution is so large that more than half the surface of the adsorbing metal is already covered. For smaller concentration the amount of adsorption, in accordance with anticipation, is found to vary with the temperature. A secondary type of adsorption of metal ions is observed when the non-noble metal is incorporated as a small constituent of a complex anion. This effect is studied in the case of the adsorption at 20° C. of Pb and Ag at a Ni surface in 12% HCl solution through which a stream of H_2 flowed. [See following Abstract.] J. S. G. T.

3975. Displacement of Equilibrium by Adsorption of Metal Ions on Pt. O. Erbacher. *Zeits. f. phys. Chem.* 182, Abt. A. 4, pp. 256-264, 1938.—By results obtained from the study of the adsorption of Pb from a 12% solution of HCl on a Pt surface bathed with H_2 and either polished or rubbed with emery, it is concluded that the equilibrium of the reaction $[\text{PbCl}_4]^{2-} + 2\text{H}^+ \rightleftharpoons \text{Pb}^{2+} + 4\text{Cl}^- + 2\text{H}^+$ is markedly displaced towards the right due to a primary adsorption of Pb^{2+} ions, although the equilibrium concentration of these ions in the solution is only 10^{-7} . A comparison of the adsorption by both types of surfaces (polished or rubbed with emery), leads to the conclusion that the actively-adsorbing regions are of atomic dimensions. [See preceding Abstract.] J. S. G. T.

3976. Wetting and Corrosion of Metals in Polyphase Systems. Part V. D. I. Mirilis. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19, 6-7, pp. 483-488, 1938. In English.—On account
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of its hydrophilic nature, Al is more strongly resistant than Fe to corrosion in the benzene and aqueous phases of a system containing fatty acids. On an Al surface activated by a 0.01% solution of corrosive sublimate, a chemically fixed adsorbed layer of the surface active acids is formed, provided no oxide film is present. It is confirmed that the moisture in liquid hydrocarbon fuel is active in producing corrosion, particularly in the presence of an electrolyte, and chiefly stimulates the selective linear corrosion of metals on the three-phase boundary line. Its removal greatly reduces local corrosion. [For Part IV see Abstract 78 (1938).] P. H. B.

3977. Surface Tension by the Ring Method. D. G. Dervichian and C. Clark. *Comptes Rendus*, 207. pp. 277-279, July 25, 1938.—

(1) The calculations of surface tensions from observations by the ring method can be facilitated by means of the empirical relation $\gamma/d = a(P/d) - b$, where γ = surface tension, d = density, P = tension, a is a constant for a particular ring and increases with decreasing ring diameter, and b is roughly constant for all rings. (2) The liquid surface is separated into two parts by the ring. By introducing oleic acid films on to one or other of these parts separately it was verified that the meniscus shapes outside and inside the ring are independent of each other, as assumed in the theoretical treatment by B. B. and H. Z. Freud. P. H. B.

3978. Effect of Temperature on Interfacial Tension between Castor Oil and Water. J. J. Trillat and P. Nardin. *Comptes Rendus*, 207. pp. 291-293, July 25, 1938.—Measurements of the interfacial tension were made by the ring method, both 2 min. after formation of the interface, and 24 hr. afterwards. Above 45° C. the values are constant and equal. At reduced temperatures the dynamic values fall somewhat but the static values fall much more sharply. Photographic measurement of the position of the ring under the action of a constant tension confirmed these results and showed that the full difference developed in about 8 hr. The results are explained by molecular orientation. At higher temperatures the orientation is opposed by thermal agitation. P. H. B.

3979. Single Crystal Cleavage on Metal Surfaces in High Vacua. W. Kluge. *Phys. Zeits.* 39. pp. 582-585, Aug. 1, 1938.—A method is described by which single crystal cleavage on metals in high vacua may be produced. The results with Zn are described and the general application of the method to problems in surface physics is indicated. F. C. C.

3980. Structure of Polished Metal Surfaces. E. Plessing. *Phys. Zeits.* 39. pp. 618-620, Aug. 15, 1938.—The work of Dobinski [see Abstract 1459 (1937)] on polished metal surfaces is repeated using as polishing medium a leather-covered wheel under benzene. Polishing times of 15 hours and longer were employed, and whilst Au and Ag gave results in agreement with those of Dobinski, the positions of the Ni, Cu and Fe haloes agreed with the earlier work of Raether [see Abstract 5440 (1933)]. After heating in a high vacuum, the polished surfaces gave diffraction patterns characteristic of the crystalline metal without a trace of oxide. It is suggested that the difference between Dobinski's results and those of other workers is to be attributed to inadequate polishing of his specimens rather than to the formation of oxide on the polished layers examined by Raether. Insufficiently polished surfaces would give haloes caused by the broadening into one another of the 111 with the 200 and 220 with the 311 diffractions respectively. Comparison of VOL. XLI.—A.—1938.

Dobinski's results with the values to be expected from a very fine grained powder of the corresponding metal gave support for this view. A. G. Q.

3981. Molecular Volumes and Parachors of Mercuric Halides and their Group Relationships. E. B. R. Prideaux and J. R. Jarratt. *Chem. Soc., J.* pp. 1203-1205, Aug., 1938.—Previous work has shown that molar volumes of liquids usually exceed the atomic volumes of their constituents under corresponding conditions, such as equal vapour pressures, the proportionate excess being different for each compound in a series such as the mercuric halides. These differences are mainly due to differences in intermolecular volumes or covolumes, which are controlled by internal pressures. These pressures, identified with van der Waals molecular attractions, a/V^2 , are increased in heteropolar molecules, which have semipolar or polar bonds. The electronic systems of the molecules, through this mechanism, affect all the properties dependent upon covolume and internal pressure, including coefficients of expansion, surface tensions, and parachors. These properties have been evaluated for mercuric, cadmium, and zinc halides. In particular, the parachors of mercuric chloride and bromide have been determined by the method of maximum bubble pressure. Parachors were found to be lower than the sums of the atomic parachors in each case, but a correction for semipolar bonds brings the values into much closer agreement. AUTHORS.

3982. Monolayers of Isomeric Unsaturated Compounds. J. Marsden and E. K. Rideal. *Chem. Soc., J.* pp. 1163-1171, Aug., 1938.—The properties of monolayers of a number of *cis*- and *trans*-unsaturated long-chain acids and alcohols have been examined. Their behaviour suggests that the *trans*-structure can form close-packed films by interlocking, which is impossible in the bent *cis*-form. This view is supported by the examination of mixed films, where it is found that *trans*-unsaturated chains can pack with saturated chains but that the *cis*-form causes expansion. Supplementary evidence is obtained from the oxidation rates of the two isomers in monolayers, which, for the *trans*-isomer, is shown to be very susceptible to compression. The properties of the "*cis*"- and "*trans*"-dihydroxy-acids are of interest in that the *trans*-form produces solid films which can be attributed to hydrogen bonding, suggestive in consideration of filamentous hydroxyl-containing macromolecules. The "*cis*"-dihydroxy-acid appears to be formed almost exclusively on oxidation at interfaces. AUTHORS.

See also Abstracts 3886, 4220, 4222, 4264, 4267, 4268, and 2856B. Transfer of Pressure on Lubricated Cylindrical Surfaces. W. Pepper.

VISCOSITY AND FRICTION.

3983. Viscosity and Density of Aqueous Solutions of Weak Electrolytes at 35° C. M. K. Srinivasan and B. Prasad. *Faraday Soc., Trans.* 34. pp. 1139-1141, Sept., 1938.—For weak electrolytes the Jones and Dole equation is shown to assume the form $\eta/\eta_0 = 1 + A\sqrt{ac} + \beta(1-a)c$, where "*A*" has the customary meaning. The value of "*A*" found experimentally is 0.020 for acetic, 0.03 for salicylic, 0.02 for succinic and 0.00 for benzoic acids. For acetic acid the calculated value is 0.0031 and for the other acids it should be of the same order. In all cases density varies linearly with concentration for dilute solutions. AUTHORS.

3984. Internal Friction of Wood. F. Krüger and E. Rohloff. *Zeits. f. Physik*, 110. 1-2. pp. 58-68, 1938.—The logarithmic decrements VOL. XLII.—A.—1938.

of transverse oscillations of frequencies 10-700~ and of longitudinal oscillations of frequencies 2,000-10,000~ are determined for pine, maple, Scotch pine and oak. Values of the log. dec. extrapolated to zero amplitude are found to be independent of frequency, for both types of oscillation; this is in agreement with Boltzmann's theory. Values of the log. dec. for the various woods increase in the sequence just stated, that for pine being least. The log. dec. for samples of wood cut transverse to the wood fibres was 3.5 times the value of the log. dec. for samples cut parallel to the fibres. Coating the samples with varnish caused an increase of about 40% in the value of the log. dec.; soaking in water for about 12 hr. caused an increase of about 75% in the value of the log. dec. in one case. The results indicate that pine and maple woods are the most suitable for the construction of resonators in musical instruments. J. S. G. T.

See also Abstract 3039.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

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*3985. Step of Equatorial Micrometer Screw. A. Fresca. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 508-518, April-June, 1938.—A report on astronomical observations and their reduction, undertaken to determine, by different methods, the accurate value of the step of the micrometer screw of the equatorial instrument.

*3986. Image-Slicer for Reducing Loss of Light at Slit of Stellar Spectrograph. I. S. Bowen. *Astrophys. J.* 88. pp. 113-124, Sept., 1938.—The fraction of the light in a stellar image that passes the slit of a spectrograph is calculated, and the limitations on any increase of this fraction by changes in the lens or mirror system are discussed. It is shown that most of this light may be made to pass the slit by means of a device, here described, which slices up the image into a series of strips of a width equal to that of the slit and which arranges them end to end along the slit. The wide spectrum thus produced can be narrowed down by means of a cylindrical lens, thereby increasing the intensity of illumination at the photographic plate by factors ranging up to 10 or more. The aberrations of the cylindrical lens used to narrow the spectrum are discussed. AUTHOR.

COMETS AND METEORS.

3987. Intensity Distribution in the Bands of Cometary Spectra. P. Swings and M. Nicolet. *Astrophys. J.* 88. pp. 173-181, Sept., 1938.—The exceptional intensity distribution of bands of unsymmetrical molecules like CN and CH in comet spectra can be explained by taking into consideration the following factors: (a) the frequency of electronic absorption processes; (b) the distribution in the vibrational levels (ground state) which is a function of the nuclear temperature T_1 or of the equivalent radiation temperature T_1 ; (c) the distribution in the rotational levels corresponding to the nuclear temperature. These factors are different functions of the heliocentric distance r . AUTHORS.

COSMOGONY.

3988. Application of the Velocity-Distance Relation for Spiral Nebulae to Milne's Universe. W. Fricke. *Zeits. f. Astrophysik*, 16. 3. pp. 196-197, 1938.—McVittie has criticised [see Abstract 3582 (1938)] Fricke's arbitrary identification of a theoretical velocity-distance relation in Milne's universe with that observed. Fricke now re-states his belief in the correctness of the identification. G. C. McV.

See also Abstracts 3956, 3993.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3989. Problem of n Bodies. Y. Hagihara. *Comptes Rendus*, 207. pp. 390-393, Aug. 17, 1938.—The differential equations for the n -body problem can be reduced to a system of equations of order $6n-12$ by elimination of the time t and of the angle defining the line of nodes. In this paper a modification of the reduction process is employed which avoids the explicit appearance of t . A. Hu.

LATITUDE AND LONGITUDE.

3990. Astronomy in Navigation. G. W. Mixer. *Frank. Inst., J.* 226. pp. 133-161, Aug., 1938.—The history of the methods and devices used in finding latitude and longitude at sea from astronomical observations is traced from the earliest times. Changes introduced since 1900 in the interpretation of and methods of utilising the well-known fundamental principles of the subject are attributed mainly to the introduction of Sumner lines, or tangents to the circles of equal altitudes of the navigational bodies. Marcq St. Hilaire's method of plotting Sumner lines by assuming a trial line at the dead-reckoning position and correcting this line by the method of altitude differences is outlined. The methods in present use are illustrated by means of the plotted course of a typical voyage. A. Hu.

NEBULÆ.

3991. Distribution of Galaxies in Northern Milky Way. H. Shapley and R. Jones. *Harvard Coll. Obs., Bull. No. 909*. pp. 1-3, July 1, 1938.—The authors have examined 58 plates taken with the 16-in. Metcalf telescope for outlining the total absorption in low galactic latitude constellations of Perseus, Cassiopeia and Andromeda, the average stellar magnitude being 18.1 with a dispersion of about 0.15. A plot of 9,000 galaxies is given. Seyfert's results are corrected [see Abstract 2462 (1937)]. Hubble's are confirmed, showing that galaxies do not approach the Milky Way, here, in northern latitudes; the "window" being on the south side. In the richest parts of the region surveyed the frequency of galaxies is equal to that in the 1st quadrant of the south galactic cap. A. S. D. M.

3992. Diffuse Nebula NGC 1982 of Orion Group Photographed in Red and Infra-Red Light. J. S. Paraskevopoulos. *Harvard Coll. Obs., Bull. No. 909*. pp. 4-5, July 1, 1938.—Photographs are given exhibiting the striking contrast between red and blue exposures (two are in blue, one in red and one in infra-red) of the small nebula in the Orion group (NGC 1982). This surrounds a fairly bright star, Bond 734, of early spectrum type, B1 (Hubble) or B8 (Cannon) which exhibits "very strong reddening" suggesting "a position within or behind the nebulosity";

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raises the question of the depths to which the red-sensitive photographs penetrate in diffuse nebulae; and requires a knowledge of the size and thickness, density and constitution of the diffuse nebulae, which are associated with dark interpenetrating clouds. It is suggested that the apparent separation of the main body of the Orion nebula by a dark passage devoid of stars from the small nebula may be due to a thick black cloud and that the two nebulosities are really one. A. S. D. M.

3993. Metagalactic Density-Gradient. H. Shapley. *Nat. Acad. Sci., Proc.* 24. pp. 282-287, July, 1938.—By counting galaxies to the uniform magnitude limit of 17.9 across the south galactic pole, it is shown that the frequency of galaxies in a direction transverse to the line of sight changes by several hundred per-cent over the region surveyed. It is pointed out that Hubble has used a radial density gradient of 20% between apparent magnitudes 18 and 21.03 to determine the expansion of the universe. Such a gradient is probably an insignificant feature of metagalactic structure, in view of the much larger transverse gradient now revealed. G. C. McV.

3994. Magnitudes of Extra-Galactic Nebulae. G. C. McVittie. *Observatory*, 61. pp. 209-214, Aug., 1938.—The author criticises the forms assumed, in discussing the observations made on the extra-galactic nebulae, for the relation between the red-shift and the apparent photographic magnitude m , on the one hand, and that between m and the number N of nebulae counted in the whole sky down to magnitude m , on the other. General relativity shows that a unique magnitude correction for the dimming effect of the red-shift does not exist, i.e., that the corrections to m are different in the two formulæ. It is therefore concluded that determinations of the structure of the universe by direct comparisons between terms in the empirical and theoretical (N, m) formulæ are untrustworthy, the results thus obtained depending chiefly on the assumed form of the empirical relation. The author's more indirect method is not open to this objection. It shows that a certain class of hyperbolic model universes of large radius represents the observations best. A. Hu.

See also Abstracts 3988, 3995.

STARS.

3995. Theory of Cyclical Transitions. L. G. Henyey. *Astrophys. J.* 88. pp. 133-163, Sept., 1938.—The general theory of cyclical transitions in the absence of collisions is discussed, first for a finite number of discrete states. It is found that the rigorous treatment of the radiation field can be carried conveniently to a fairly advanced state, short of the complete solution of the problem. It is found that there exist a number of first integrals of the differential equations, some of which are generalisations of the constancy of the net flux and of the linear dependence of the radiation pressure on the optical depth in the simple scattering problem. The remaining integrals are simple relationships among the optical depths in the various frequencies. The second part of the discussion is devoted to a study of the properties of the radiation field when the exciting radiation is highly diluted. The approximation appropriate to a high dilution is introduced, and it is found that the problem can be completely solved to within the Milne-Eddington approximation to the directional dependence of the specific intensity. The boundary conditions for a planetary nebula are introduced, and the values of the emergent fluxes are obtained.

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Physically the approximation for a high dilution is equivalent to neglecting the transitions corresponding to stimulated emissions and those corresponding to absorption when the lower state is not the ground state. However, these facts do not constitute the basis for the approximation; it is introduced from more fundamental considerations. The last part of the theoretical discussion pertains to the generalisation of the theory to an infinite number of discrete states together with a continuum. This formal extension follows in a natural way and depends on no new physical concepts. Finally there is a section devoted to some computations on the four-state problem for a planetary nebula. One interesting result is the weakness of the (1, 3) radiation ($\text{Ly } \beta$ for hydrogen) when the fourth state is identified with the continuum. AUTHOR.

3996. Temperature Distribution in Stellar Interiors. G. Tiercy. *Arch. des Sciences*, 20. pp. 123-145, May-June, 1938.—The history of the subject is traced up to the introduction by Bialobrzeski of radiation pressure into the equations of stellar equilibrium, and of the notion of the polytropic nucleus. Thence the author confines himself to the peripheral regions, develops the fundamental equations of radiative equilibrium, and gives an approximate solution for the temperature distribution in these layers. Numerical values are given for a star whose central temperature is 10^7 and whose effective temperature is 5200°C .

A. Hu.

3997. Convective Stability of Stellar Atmospheres Comprised of Doubly Ionised Atoms. Y. Fujita. *Phys. Math. Soc. Japan, Proc.* 20. pp. 484-505, June, 1938.—The effect of convection is considered for the case of a stellar atmosphere in which neutral, singly and doubly ionised atoms of n different gases are present. Generalisation of Chandrasekhar's absorption coefficient to doubly ionised atoms gives $P = \sqrt{2g} T_0^{9/4} \cdot \sqrt{F}$, where P is the gas pressure and F a function of τ the density. Corresponding to the condition for convection stability one finds for these atmospheres $\frac{1}{\eta} > \frac{1}{4} (4 + 6\tau) \cdot dF/d\tau/F$, where η is a function of the fractions of the various singly and doubly ionised elements present. The H convection zones are calculated numerically for singly and doubly ionised solar atmospheres containing the mixture of atoms given by Russell; it is concluded therefrom that the convection zone appears at $\tau = 2.0$ and reaches to the inner parts of the sun. The life periods of granules and spots are determined from the convective energy transport equation as 2.5 to 4.8 min. and 9 days respectively; these values are in good agreement with observation. J. E. K.

3998. Density Condensations in Stellar Interiors. Z. Kopal. *Observatory*, 61. pp. 201-208, Aug., 1938.—The internal density concentration in the components of close binary systems is obtainable from their orbital distortions, which give rise to variable longitudes of periastron, observable in some cases, and also from their distortions of form caused by mutual tidal interaction, obtainable from the light-curves. The history of both methods is traced and the surprisingly small condensations yielded are discussed. The possible sources of error in the author's conclusion that the density condensations increase with advancing spectral type are investigated. The inevitable assumption that the structure of both components is the same is the weak point. Chandrasekhar's method depending on the H content of single stars suggests that early-type stars are weakly condensed, whereas with Cepheids the

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opposite appears to be the case. At any rate, all methods of approach indicate that the classical models give far too highly-condensed interiors.

A. Hu.

3999. Nuclear Transformations as the Source of Stellar Energy. G. Gamow. *Zeits. f. Astrophysik*, 16. 3. pp. 113-160, 1938.—The present state of our knowledge of the subject is dealt with under the following heads: general facts of nuclear transformations; velocity of thermal transformations; chain reactions in the nucleus; stellar models based on nuclear transmutations as the energy source; constitution of the nucleus; extremely dense matter in stars; stellar pulsations and explosions. It is concluded that our present knowledge of the properties of matter suffices to begin an attack on the question of stellar evolution; the best hope for the future lies in close collaboration between physicists and astronomers.

A. Hu.

4000. Theorems in Stellar Structure. W. Gleissberg. *Zeits. f. Astrophysik*, 16. 3. pp. 185-195, 1938.—Inequalities are worked out for a number of integrals which arise in the theory of stellar models in radiative equilibrium.

G. C. McV.

4001. Non-Radial Oscillations of Stars. Part I. C. L. Pekeris. *Astrophys. J.* 88. pp. 189-199, Sept., 1938.—In the first part of this paper a derivation is given of the Eulerian equations which govern the small and adiabatic oscillations of a general spherical harmonic type of non-rotating stars. These equations are then solved for a model of constant density. It is shown that with the exception of purely radial oscillations, which are unstable only when $\gamma < 4$, there exist non-radial modes of oscillation, which are unstable for all values of γ . The conclusion is drawn that in the pulsation theory of stellar variability it is necessary to consider non-radial disturbances in order to ascertain the possibility of the existence of any assumed model.

AUTHOR.

4002. Theory of Interstellar Absorption. J. L. Greenstein. *Harvard Coll. Obs., Circ. No. 422*. [36 pp.], 1938.—The author discusses the types of interstellar material capable of producing the observed absorption in space and its variation with wave-length. The Mie theory of the scattering of light by small solid particles is used to derive theoretical extinction coefficients for small dielectric and metallic particles. The Oort-Kapteyn theory, providing an upper limit to the density of dark matter in space, is used in conjunction with the classical efficiency factors to compute the extinction coefficients per gm. for electrons, molecules and dust particles as functions of their space density. From these results the optical properties of mixtures of various particle sizes are calculated, using an extrapolation of the observed frequency distribution of hyperbolic meteors. Absorption varying with $1/\lambda$ is exhibited by a mixture of particles of diameters a with a frequency distribution of the form $a^{-3.6}$, the space density of the solid material being about 2×10^{-25} gm./cm³. The effect on the postulated distribution of a possible expulsion of small particles from the galaxy by radiation pressure is investigated. Turbulence caused by encounters with highly luminous stars has probably well mixed the particles of various sizes in space.

A. Hu.

4003. New Spectrum Variable: 5 Lacertae. J. A. Hynek. *Astrophys. J.* 88. pp. 201-204, Sept., 1938.—Sharp lines of H and K of Ca II, superposed on the broad H and K lines of the cK5 component of the composite star, 5 Lacertae (K5AOs), are found to vary in intensity

and radial velocity. The velocity of the late star, regarded as constant for many years, is also found to be variable. AUTHOR.

4004. Photometric Observations in Different Colour Regions of the System U Sagittae. K. Walter. *Zeits. f. Astrophysik*, 16. 3. pp. 167-184, 1938.—U Sagittae belongs to the Algol system and consists of a bright small component of early type (B9) and a faint large component of later type (G2). In a previous investigation the author showed that in such a system the bright component should be spherical but the faint one very elliptically deformed. In order to test this photographic brightness measurements of the variables are made in two different wave-length regions (430 m μ and 610 m μ) and the normal curves are derived. In accordance with theory the blue light curve is found to be of "Algol type" and the red curve of " β Lyrae type"; the ellipticity of the faint component is quantitatively also in good accord with theory. Both light curves show interesting characteristic detail; the times of the principal minima coincide for both colour regions and the reflection constants are remarkably small. The edge darkening of the G2 components can be estimated from the depth of the subsidiary minimum. J. E. K.

4005. Hydrogen Band Width in Nova Herculis. E. G. Williams. *Observatory*, 61. pp. 214-216, Aug., 1938.—The observation that the contours of H β , H γ , and H δ in the pre-maximum spectrum of Nova Herculis are dissimilar [see Abstract 3955 (1937)] may be due to instrumental factors. Photographs taken at Mt. Wilson on higher dispersion, however, show the same effect, the agreement in contour being satisfactory. H β is very blunt, and its great width cannot be attributed to blends on the red wing. The difference is therefore real. Post-maximum plates show no such difference. A. Hu.

4006. Bright Line Intensities in Nova Pictoris Spectrum. C. Payne-Gaposchkin and D. H. Menzel. *Harvard Coll. Obs., Circ. No. 428*. [13 pp.], 1938.—An attempt to utilise the unpublished plate material of Nova spectra in many observatories. The method adopted is to use the observed light curve as the fundamental datum and to adjust the intensity scale of each spectrum to fit the observed magnitude of the Nova on the corresponding date, eliminating possible systematic error arising from the failure of the reciprocity law for low intensities of light. The theoretical basis of this is given, with tables and diagrams from the Harvard and Lick plates of Nova Pictoris. All the lines observed show a gradual decline in average intensity; for the same atom they change in similar fashion, but exceptions are given. From the rough parallelism of the intensity lines, the relative intensities can be approximately valued. The continuous background still fluctuated when the starlight was relatively steady and was bound up with the bright-line spectrum.

A. S. D. M.

4007. Light-Curves of Cepheids. M. Schwarzschild. *Harvard Coll. Obs., Circ. No. 429*. [7 pp.], 1938.—The difference between Eddington's solution of the differential equation for adiabatic radial pulsations and the author's [see Abstract 1045 (1938)] is illustrated by a hydrodynamical analogy in which the properties of standing and progressive waves are contrasted. It is shown that the radiation flux through a layer of the star's interior is a function of the density of the layer, and thence that in the case of a standing wave the light-variation is affected by the velocity of the material, whilst it is not in the case of a progressive wave. The possibility of explaining the similarity in form and phase between the

light- and velocity-curves of a classical Cepheid by assuming a progressive wave in the outer envelope is therefore explored. The light-curve corresponding to a given velocity-curve on this basis is derived from the energy law, and the laws of continuity, motion, and radiative transfer, and is shown to be of the required form. A. Hu.

4008. Eclipsing Binaries with Apsidal Motion. H. Shapley and H. Swope. *Harvard Coll. Obs., Bull. No. 909. pp. 5-9, July 1, 1938.*—The authors examine Luyten's list of 8 binaries and discuss three systems [see Abstract 3541 (1936)]. For KTCentauri the apsidal rotation must be exceedingly slow; for GN Normae, it must be more than a thousand years; and for YY Sagittarii it is not less than 300 years, and here the data might even suggest a regressing line of apsides. A. S. D. M.

4009. Observations by American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann. 107. 1. pp. 3-41, 1938.* [See also Abstract 3157 (1938).]

4010. Reduction of Visual Catalogues to the Harvard Photovisual System. C. Payne-Gaposchkin. *Harvard Coll. Obs., Ann. 89. 12. pp. 191-199, 1938.*—A reduction of the magnitudes of 40,000 stars to the Harvard photovisual system has been completed. It is shown that the mean errors of the average magnitudes have been significantly reduced by the systematic corrections that have been applied to the original magnitudes. A catalogue of the magnitudes of stars north of $+80^\circ$ is given, and the Harvard magnitudes are shown to have a very small accidental error by comparison with the catalogues of the same stars published by the Mount Wilson and Leiden observatories. The relation between the Harvard and the International photovisual systems is determined to be: $IP_v - HP_v = +0.10 + 0.06 C_c$. The colour excesses for stars of early type north of $+80^\circ$ are shown to be related to the presence of obscuration detected by other means. AUTHOR.

See also Abstract 3961.

SUN.

4011. Ionospheric Eclipse of 1940, Oct. 1. *Roy. Astron. Soc., M.N. 98. pp. 664-669, June, 1938.*—Projections on the earth of the paths of totality, for the optical eclipse at heights of 100 and 300 km. above the earth's surface, are given for those land regions where observations may be made during the 1940 solar eclipse, viz., in S. Africa and S. America. The results, presented in the forms of maps and tables, give the central line and the northern and southern limits of the track at frequent intervals of time, the geographical coordinates being accurate to $1'$. J. P. A.

4012. Fraunhofer Intensities in the Infra-Red Region. C. W. Allen. *Mt. Wilson Observat., Contrib. No. 594. Astrophys. J. 88. pp. 125-132, Sept., 1938.*—Equivalent breadths, measured photometrically on spectra taken with an 18-ft. focus spectrograph at Mount Wilson Observatory, are tabulated for 188 absorption lines in the solar spectra between 8800 and 11830 Å. AUTHOR.

4013. Analysis of Infra-Red Limit of Atmospheric Transmission. A. Adel and C. O. Lampland. *Astrophys. J. 88. pp. 182-185, Sept., 1938.*—The correspondence between the related set of CO_2 bands at 15μ and the infra-red limit of atmospheric transmission is discussed in detail. A sample curve of atmospheric transmission in this spectral region is given by way of illustration of the detail actually present

in what had formerly been considered a featureless, smooth curve. [See also Abstract 1554 (1938) and following Abstract.] **AUTHORS.**

4014. Rock-Salt Prismatic Solar Spectrum. A. Adel. *Astrophys. J.* 88. pp. 186-188, Sept., 1938.—New features in the infra-red telluric spectrum, made apparent with increased resolving-power, are briefly discussed. [See preceding and following Abstracts.] **AUTHOR.**

4015. Origin of Infra-Red Telluric Absorption Band q_2 . A. Adel. *Astrophys. J.* 88. pp. 200-201, Sept., 1938.—It is demonstrated that the telluric absorption band at 12.65μ is a member of the family of CO_2 bands which determine the infra-red limit of atmospheric transmission. **AUTHOR.**

See also Abstracts 4035, 4046.

ZODIACAL LIGHT AND GEGENSCHNITT.

4016. Galactic Matter and the Zodiacal Light. B. Fessenkoff. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 451-452, 1938. In French.—It is assumed that a stream of particles, moving within the galaxy in parallel straight lines with uniform velocity, is deflected by the gravitational attraction of the sun. The brightness of the sky in the east and in the west due to this cause is calculated and an observational check on the theory is indicated. **G. C. McV.**

GEOPHYSICS.

GEODESY.

4017. Gravity Reductions and the Figure of the Earth. B. L. Gulattee. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 323-336, 1938. In English.—The accuracy of the various formulæ for deducing the rise of the natural geoid with respect to its reference spheroid from the gravity anomalies is considered. The merits and demerits of the various reductions for reducing observed gravity from ground level to geoidal level for the above purpose are discussed. **AUTHOR.**

GEOPHYSICS, APPLIED.

***4018. Tests of Small Surveying Theodolites with Helical Gearing and Measuring Spindle.** K. Lüdemann. *Zeits. f. Instrumentenk.* 58. pp. 279-286, July, 1938.—Details are given of the structure and use of two small types of Hildebrand instruments. The efficiency of the instruments on the test bench and in the field has been confirmed and results are quoted showing the degree of accuracy attainable. **R. S. R.**

See also Abstracts 4026, 4257.

HYDROSPHERE, PHYSICS OF THE.

***4019. Oceanographic Current Recorder.** H. Dahl and O. Dahl. *Rev. Sci. Instruments*, 9. pp. 243-245, Aug., 1938.—A full description of the recorder which is of the propeller type is given along with line diagrams. A vane maintains the instrument against the current while the use of the diving bell principle ensures that water sensitive

parts are protected. The direction of the current is determined by measurement of the variation of electrical resistances. An amplifier which is of the d.c. type, operates the counting device. The amplifier is described in detail, and the description accompanied by a diagram.

A. E. M. G.

4020. Drift of Ice-Fields. W. W. Shoulejkin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 8. pp. 589-594, 1938. In English.—The theory relating ice drift velocity (u) to wind velocity (V) is established. It is found that when V is slight u/V tends to zero, but as V increases, u/V increases rapidly and then more slowly as the angle between the two directions approaches a limit. The results are compared with the motion of the Soviet Polar Drift Station. In the whole drift no traces are discovered of currents of non-drift origin. The East Greenland current is thus purely of drift origin caused by ice movement and this in turn set up by the monsoonal type of winds off the Greenland coast.

R. S. R.

4021. Horizontal Mixing of Water Masses of the Caspian Sea. W. Stockmann. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. pp. 565-568, 1938. In German.—Observations of salt content, S , and temperature, t , for different depths made over the central and southern parts of the Caspian Sea in 1933-37 were analysed. A series of $S-t$ curves were constructed to locate the various mixing regions. Layers of maximum and minimum stability were found, the latter predominating. Horizontal turbulence plays an important part in the mixing processes and with vertical stability there is an increase of horizontal mixing. The mixing processes indicate an ellipsoid with its minor axis parallel to the isopycnic surfaces.

R. S. R.

LAND, PHYSICS OF THE.

4022. Magnetic Anomalies and Subterranean Structure. T. Nagata. *Imp. Acad. Tokyo, Proc.* 14. pp. 176-181, May, 1938. In English.—Tsuboi's relation [see following Abstract] of gravitational potential to magnetic distribution is connected with Poisson's relation of magnetic to gravitational potential to obtain the magnetic intensity distribution along the subterranean mass directly from magnetic observations on the earth's surface. Examples are given of the application of the method to the analysis of magnetic anomalies. The theory gives results agreeing well with experimental values obtained by boring at Kursk.

R. S. R.

4023. Gravity Anomalies and Subterranean Mass Distributions. C. Tsuboi. *Imp. Acad. Tokyo, Proc.* 14. pp. 170-175, May, 1938. In English.—The subterranean mass distribution can be determined approximately from the corresponding gravity values by assuming that the mass distribution can be replaced by that concentrated on the subterranean plane situated at the average depth of the boundary of different densities. The theory of the method is given. Examples are given of its application to (1) Eötvös relation of gravity gradients and subterranean mass distribution, (2) Meinesz's gravity measurements in the East Indies, (3) surface topographic relief and Bouguer anomalies, and (4) Bullard's gravity measurements in the African rift. [See following Abstract.] R. S. R.

4024. Gravity Anomalies and Subterranean Mass Distribution. Part II. C. Tsuboi and T. Fuchida. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 273-284, June, 1938. In English.—Previous work
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[see Abstract 5207 (1937)] is extended from a two-dimensional to a three-dimensional distribution of gravity anomalies by an application of the potential theory. [See also preceding Abstract.] W. A. R.

4025. Structure of the Earth. S. v. Bubnoff. *Naturwiss.* 26. pp. 490-493, July 29, 1938.—Reference is made first to Kossmat's view that the N. pole lies in a bay surrounded by old continents while the S. pole lies in an old, earlier solidified, block of the Antarctic. The growth of the northern continent (Europe, Asia, America) has been by sliding along lines of folding with cores over Canada, Scandinavia and Finland, and East Siberia, while the southern continent has broken up along the lines of the Atlantic and Indian Oceans. Climatic and geological evidence in support of these views is discussed. The views lead to the idea of the whole earth's surface acting as a quasi-homogeneous region of deformation. The relation of these views to Wegener's continental drift theory are examined. R. S. R.

4026. Structure of the Earth as Revealed by Seismology. E. A. Hodgson. *Roy. Astron. Soc. Canada, J.* 32. pp. 273-298, July-Aug., 1938.—After introductory remarks on earthquake zones, seismographs, and types of waves the refraction method to determine the thickness of the earth's crust is explained. The time-distance graph used to get velocities at any depth in the mantle is considered next and particularly the Herglotz-Wiechert method. Information relating to the core is largely incomplete for reasons given. Lastly the use of the reflection method for a survey of the upper crust in locating oil-bearing layers is discussed. R. S. R.

4027. Gravitational Stability of the Earth at its Liquid Cooling Stage. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 234-243, June, 1938. *In English.*—The stability of the earth would depend upon the size of any masses which have cooled, become denser, and sunk. A pear-shaped, ellipsoidal, or even a tetragonal deformation in a past liquid state of the earth is possible. [See following Abstract.] W. A. R.

4028. Effect of Cooling on a Plastic Earth under Gravitational Forces. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 244-255, June, 1938. *In English.*—The effect of cooling of any layer on the plastic deformation of the earth under gravitational forces is small. Cracking is not likely to occur, or to be very marked, unless the earth is incompressible in the earliest stage of consolidation. [See preceding Abstract.] W. A. R.

4029. Ground Movement in Mines. H. P. Greenwald. *J. of Applied Physics*, 9. pp. 567-572, Sept., 1938.—The compression tests of blocks of potash-bearing salt indicated that load on mine pillars composed thereof should not be much more than 2,000 lb./in². when these pillars are expected to stand a considerable number of years. So long as the roof strata remain unbroken, there is little likelihood of shearing along the edges of pillars. Apparently the immediate roof stratum is sufficiently thick to permit development of the arch-shaped crack without having this crack reach the top of the stratum. It is a crack of this nature that should be looked for as a first indication that the roof is overloaded. The observed behaviour of these materials, which results in large part from their plastic properties is of great practical importance as it is possible to devise methods of mining by which practically all of the valuable potash-bearing salt can be recovered without breaking the roof. Instead,

the roof can be made to subside gradually into the area from which the potash-bearing salt has been removed. [See also Abstract 3964 (1937).] AUTHOR.

4030. Normal to Tangential Viscosity Ratio and Poisson's Ratio in Soils. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 391-406, June, 1938. In English.—Experiments are described showing the relations between the normal (γ_n) and tangential (γ_t) coefficients of solid viscosity, Young's modulus (E), the modulus of rigidity (μ) and the water content of the soils previously examined [see Abstract 2483 (1937)]. All four diminish rapidly with increased water content, while the Poisson ratio and $m [= (E/\mu)/(\gamma_n/\gamma_t)]$ increase therewith; λ^1/μ^1 (where λ^1 and μ^1 are viscous coefficients similar to Lamé's constants λ and μ) assume an increasing negative value as the water content increases, the soil behaving more and more like a viscous fluid. C. A. S.

4031. Grain Structure and Water Content of Sand Dunes. R. A. Bagnold. *Nature*, 142. pp. 403-404, Aug. 27, 1938.—Two types of sand accumulation are distinguished (1) encroachment due to sand accumulating on the upper sheltered part of the slope thus increasing the angle of shear until an avalanche occurs, and (2) accretion due to layers formed parallel to the surface exposed to the wind. The former is soft and has a loose packing but the latter is firm and the grains are close and orderly. With the former rain seeps rapidly to depths where temperature and evaporation have no effect but with the latter there is lateral spreading of the water and rapid evaporation. R. S. R.

See also Abstract 3935.

METEOROLOGY.

4032. Radiation Properties of the Snow-Cover. C. Thams. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 371-388, 1938.—A report is given of researches upon the radiation properties of the snow-cover. These investigations consist mainly of measurements of the reflection power as well as of the absorption power. The albedo (reflection power) of new snow is on the average 0.82, for old snow it goes down to 0.60 and for melting snow to 0.50. The records of the snow albedo show sensible alterations in the course of days and even hours. The measurements of the transmission have given as result a mean value of 0.083 for the absorption coefficient of the snow-cover. By means of a few examples it is shown to what extent radiation energy falls upon the snow-cover, is reflected by the surface and absorbed by the various layers of snow in the different winter months. AUTHOR.

4033. Atmospheric Soundings by Luminous Rays. Part II. J. Duclaux. *J. de Physique et le Radium*, 9. pp. 259-261, June, 1938.—The method [see Abstract 5064 (1936)] has been further developed by using a high pressure mercury-vapour lamp at the focus of a parabolic mirror. Exposures of 1 hr. are considered satisfactory. The beam divergence has been reduced to 0.2 in 100 and further reduction is desirable. Panchromatic plates are less satisfactory than ordinary plates with a filter passing 3600 to 4400Å. G. C. E.

***4034. Upper Air Investigations and Radio Meteorographs.** R. R. Bajpai. *Science and Culture*, 4. pp. 8-14, July, 1938.—After referring to earlier methods of upper air investigation and generally

indicating the several faults from which these various methods suffered the author proceeds to discuss the radio meteorometric equipment. This equipment is furnished with instruments to measure the meteorological elements at certain points and to transmit the measurements to a conveniently situated station. Two main types of instrument are in use, the constant and the variable frequency meteorograph. A full description of each type is given. Two examples of each kind are considered and a detailed account given of the methods of recording. The paper is illustrated by a number of diagrams and photographic reproductions.

A. E. M. G.

4035. Application of Line Integral Theorems of Hydrodynamics to Terrestrial and Cosmical Vortices. H. Philipps. *Naturwiss.* 26. pp. 457-460, July 15, 1938.—Shows how the results of v. Bjerknes concerning the kinematic and dynamic circulations explain certain phenomena connected with land and sea breezes, the general circulation of the atmosphere, and sunspots.

W. G. B.

4036. Vertical and Horizontal Interchange in the Light of the Problem of Motion of Projectiles. H. Arakawa. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 273-276, 1938.—The motion of a small air particle in the gravitational field of the earth is calculated. With the help of the problem of projectile motion it is shown that (1) horizontally the lateral mixing is essentially operative as in the vertical, (2) the smaller the temperature decrease with height in the atmosphere the greater is the lateral mixing and the smaller the vertical mixing, (3) in labile air masses the disturbance limits itself to small regions such as showers and fronts, and (4) if the air is in moist labile layers the increase of height of the projectile track is sufficient to bring about an interchange.

R. S. R.

4037. Tropical Cyclones. E. Gherzi. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 316-322, 1938. *In English.*—The paper contains criticisms on articles published by different authors on the nature of tropical cyclones. Some of the points considered are, the conditions in, and cause of a typhoon and the origin of the air masses within it, certain characteristics, e.g., the "dangerous semi-circle," the escape of air from the cyclone and its direction of motion.

A. E. M. G.

4038. Colour of the Night Sky. R. Grandmontagne. *Comptes Rendus*, 207. pp. 275-277, July 25, 1938.—Observations of the energy distribution in the spectrum of the night sky have been made with a self-registering photoelectric photometer. The photo-cell used has a maximum sensitivity at 6200 Å and is relatively insensitive beyond 8000 Å; it is calibrated against a comparison source consisting of a tungsten lamp operated at 2100° K. The spectral regions in which measurements are made are isolated by means of filters with cut-offs below 5800, 6550, and 7000 Å respectively. The curve given shows a maximum from 7000 to 9000 Å separated by a minimum around 6800 Å from a second lower peak at 6100 Å. The energy is very low in the blue and violet. The measurements are means of observations made over 4 months: diurnal and annual variations are therefore smoothed out [see following Abstract].

A. Hu.

4039. Annual Variations in the Colour of the Night Sky. R. Grandmontagne. *Comptes Rendus*, 207. pp. 321-323, Aug. 1, 1938.—Observations similar to those previously described [see preceding Abstract] have been made on all clear nights free from mist and moonlight from May, 1937, to April, 1938, inclusive. The energy in the region 5800-9000 Å is plotted against epoch. Three maxima are shown: one in Nov. corres-

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pondering to that found by Rayleigh and Spencer Jones [see Abstract 3815 (1935)]; another smaller one in Mar. not taken into account by Rayleigh and Spencer Jones in representing their results analytically, but shown by their individual observations and by those of Cabannes and Dufay [see Abstract 2031 (1935)] on the Vegard-Kaplan bands; and a third in June and July which is attributed to solar twilight. A slight phase difference between the author's results and those of Rayleigh and Spencer Jones is attributed to the slightly shorter mean wave-length used by the latter. It is suggested that for purposes of observation of the night sky, astronomical twilight should be used (sun 18° below horizon). A. H.

4040. Intensity of the Green Ray of the Night Sky. N. Wassmuth, V. Werzner, S. Tibilov and S. Freivert. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5, pp. 405-407, 1938. *In French.*—Measurements made in 1934 indicated a variation in the intensity of the green ray of the night sky, a maximum appearing between 1h. and 2h. 30m. In 1937 this work was continued, the object being to determine more accurately the position of the maximum. A schematic drawing of the photometer used is given and curves represent the results obtained during 5 nights in August. The observations were made as before at a height of 3000 m. ($43^\circ 17' N.$, $42^\circ 28' E.$). The curves confirm the existence of a maximum with its value changing from day to day. The position also varies with time just as the 1934 work showed. This variation was confirmed by several observers making simultaneous observations independently. A. E. M. G.

4041. Atmospheric Absorption. T. Kiu. *J. de Physique et le Radium*, 9. pp. 297-307, July, 1938.—The author seeks to represent by a straight line $D = A + Bf(\lambda)$, where $f(\lambda) = (\mu_0^2 - 1)^2 \lambda^{-4}$, the optical density of the atmosphere at the zenith according to the measurements made by the Smithsonian Institution at Montezuma, Chili (altitude 2711 m., latitude $22^\circ 40' S.$) from 1920 to 1930. A distinct correlation is found between the height of precipitable water and the constants A and B. For dry air, calculation of Avogadro's number gives a value of $(6.136 \pm 0.085) \cdot 10^{23}$, which is closer to that of Millikan than values previously deduced from molecular diffusion observations. The seasonal variation of the constant A is studied and calculations made of the thickness of O_3 present each day in the atmosphere. The coefficient of absorption found by Vassy for the visible spectrum, corrected for temperature, gives results for O_3 thickness in perfect agreement with those obtained from the u.v. measurements made at Montezuma. A. W.

4042. Atmospheric Light and Visibility. H. Koschmieder. *Naturwiss.* 26. pp. 521-528, Aug. 12, 1938.—After preliminary remarks on the essential questions involved relating to day and night visibility a general formula is developed for the light of any colour reaching the eye direct from the source, and by scattering, under certain limiting conditions. Measurements carried out over, and near to, the Baltic for distances 1-4 km. show the importance of the albedo of the object reviewed, its position relative to the sun, and variations in different directions due to pollution by town smoke. Expressions are next obtained relating the atmospheric light to the distance between object and observer. This leads to the equation $h_s/h_h = 1 - e^{-3.912/s}$, where h_s is the apparent brightness of the surface, h_h the horizontal brightness, l the distance away of the object, and s the visibility distance. Bennett's results and VOL. XLI.—A.—1938.

Foitzik's comments on them are discussed. Finally the various factors are reviewed and comments made on the use of various visibility meters.

R. S. R.

4043. Sodium in the Upper Atmosphere. J. Cabannes, J. Dufay, and J. Gauzit. *Astrophys. J.* 88. pp. 164-172, Sept., 1938.—Spectroscopic and interferometer observations show conclusively that the bright yellow radiation of the night sky coincides with the two D lines and that Na atoms are always present in the upper atmosphere. At twilight the yellow radiation is increased, like the red line λ 6300 of [OI]. The writers are examining the altitude of the luminescent layer and the origin of atmospheric Na; they believe that the Na comes from meteorites. [See also Abstract 3177 (1938).]

AUTHORS.

4044. Interpretation of Aurora-Spectrum. J. Kaplan. *Zeits. f. Physik*, 109. 11-12. pp. 744-749, 1938. Vegard and his collaborators have ascribed certain bands of the aurora spectrum to $A^3\Sigma \rightarrow X^1\Sigma$ transitions in nitrogen. The author shows that eight of these assignments are wrong, and that the aurora spectrum is not identical with the ϵ -system of solid nitrogen. He proposes to differentiate between the bands of solid and gaseous nitrogen by using the denotations " $A^3\Sigma \rightarrow X^1\Sigma$ (solid)" and " $A^3\Sigma \rightarrow X^1\Sigma$ (gaseous)" respectively.

L. K.

4045. Production of Aurora Spectrum in the Laboratory. J. Kaplan. *Zeits. f. Physik*, 109. 11-12. pp. 750-752, 1938.—The author describes the characteristic aurora afterglow which he has obtained in his discharge tube. The discharge shows a blue-white colour and the afterglow is a pronounced blue in contrast to the yellow colour of the ordinary afterglow of N_2 . Two photographs are reproduced showing the spectra of the aurora-afterglow obtained in a discharge tube and of an ordinary discharge.

L. K.

4046. Halo Phenomena and Solar Activity. G. Archenhold. *Gerlands Beitr. z. Geophys.* 53. 4. pp. 395-475, 1938.—Observations of haloes over the years 1926-36 are given and typical properties of halo statistics treated, especially annual variation and the grouping of halo days. A method of elimination of the annual variation based on peculiarities of the frequency distribution is given. Comparing monthly values for an individual year high halo numbers are correlated with high sunspot relative numbers, while for a whole sunspot period the effect may be diminished or inverted. Correlation of monthly numbers of sunspot activity and magnetic character figures becomes closer if systematic differences are eliminated. Based on 73 years of observations the periodicity of 27 to 28 days, due to solar rotation is found in the appearance of haloes. It may be possible to connect active regions on the sun with individual haloes when more observations of chromospheric eruptions are available. The physical nature of the influence of solar activity on halo frequency is discussed.

R. S. R.

See also Abstracts 4013, 4014, 4015, 4224.

SEISMOLOGY.

4047. Seismic Waves Due to Traction Applied to the Inner Surface of a Spherical Cavity in an Elastic Earth. G. Nishimura and T. Takayama. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. pp. 317-354, June, 1938. In English.—Continuing previous work [see Abstract 5289 (1937)] the authors show that, when shock stresses are applied to a cavity, both longitudinal and transverse waves are excited.

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Each is composed of free, forced and complementary waves. The forced waves have the same frequency as the applied stresses; the free waves are damped simple-harmonic vibrations, whilst the complementary waves are of an aperiodic decaying character. At some distance from the cavity longitudinal waves excite only the radial vibrations of particles, whilst the transverse waves excite only the co-latitudinal and azimuthal vibrations of the same particles.

4048. Anomalous Dispersion of Rayleigh Waves. K. Sezawa and K. Kanai. *Imp. Acad. Tokyo, Proc.* 14, pp. 246-249, July, 1938.—The calculations in a previous paper [see Abstract 3627 (1938)] dealt with a special case of anomalous dispersion of Rayleigh waves. To obtain the general features of the problem calculations were extended to six widely different cases and the results are shown graphically and discussed. The nature of the velocity equation obtained three years earlier is rediscussed from a more analytical point of view. R. S. R.

4049. Seasonal Distribution of Earthquakes. S. Yamaguti. *Tokyo Univ. Earthquake Research Inst., Bull.* 16, pp. 355-365, June, 1938. *In English.*—The earth between 60° N. and 50° S. is divided up into areas 30° × 30°, and each area is numbered 1, 2, 3, and 4, according as the maximum number of earthquakes recorded in Bellamy's Catalogue of earthquakes in 1913-30 occurred in March-May, June-Aug., Sept.-Oct., or Dec.-Feb. The numbers of earthquakes in season 2 exceeds, that in 4 is below the average, but there is entire irregularity in distribution of the areas. C. A. S.

***4050. Kreis-Wanner Seismograph.** P. L. Mercanton. *Comptes Rendus*, 207, pp. 374-375, Aug. 8, 1938.—A detailed description is given of a new vertical seismograph which has been installed at Degenried-Zurich to replace the Wiechert apparatus. With an amplification of 150 times the period is 10 sec. The stationary mass is 1100 kg. An electrical method is used to compensate for temperature. The registrations obtained are remarkably good and Rayleigh and Love waves are easily recognised. R. S. R.

See also Abstracts 4026, 4027, 4028.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4051. Phase Irregularities of the Diurnal Component of the Earth's Electric Field. R. Guizonnier. *Comptes Rendus*, 207, pp. 372-374, Aug. 8, and pp. 403-404, Aug. 17, 1938.—Graphs have been made connecting longitude and the hour of maximum of the diurnal component for a pronounced perturbation using local and Greenwich time. The abnormal diurnal component is the resultant of the normal diurnal component and a semi-diurnal perturbation which is accentuated for five observatories but less marked for others. Each ordinate of the semi-diurnal component was combined with the two preceding and the two following at 6- and 12-hour intervals, to get mean values. The results are shown graphically and the amplitude of the maximum for the semi-diurnal component is accentuated. Tests with curves for Kakioka, Christchurch and Colorado confirm this view. Such a semi-diurnal variation suffices to explain the abnormal phase of the diurnal component of the earth's electric field given by analysis. [See Abstract 2037 (1935).] R. S. R.

See also Abstracts 4022, 4080, 4224.

RADIOACTIVITY.

4052. Highly Activated Atomic Nuclei. L. Goldstein. *J. de Physique et de Radium*, 9. pp. 262-272, June, 1938.—The statistical model is used to investigate the dissipation of high energy levels. Assuming strong coupling between the particles in the nucleus it is shown that the simultaneous emission of several heavy elementary particles is plausible. Rupture of the nucleus into complex fragments is improbable. Reasons are given for believing that the statistical magnitudes obtained approximate to the real values. Critical excitation energies are found for different bands, and the way in which energy is dissipated from the latter varies from band to band. It is concluded that laboratory excitation of nuclei has so far only provoked successive and not simultaneous emission. Cosmic rays can lead to shower production, the neutron-proton composition of which depends on the atomic number. G. C. E.

4053. Nuclear Excitation and Partitio Numerorum. K. Umeda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 794. pp. 629-636, June, 1938. In German.—By use of the *partitio numerorum* it is shown that the expected mean number of particles excited in a nucleus should be the $2/3$ power of the maximum number. The mathematical analogy suggests a system consisting of an unlimited number of Bose particles, the characteristic frequencies of which are the same. G. C. E.

4054. Theory of Radioactivity, Natural and Artificial, Based on Nuclear Constitution. A. Veronnet. *Comptes Rendus*, 207. pp. 121-123, July 11, 1938.—Denoting a proton by P, neutron by N, deuteron by D, and triton by T, D is composed of P + N, T of D + N, or P + 2N; and the general expression for the nucleus zA , where z is the atomic number, reduces to $zA = (3z - A)D + (A - 2z)T$. Radioactivity is explained as the result of the decomposition $2T \rightarrow \alpha + \beta + D$, or $4T \rightarrow 2\alpha + 2\beta + 2D \rightarrow 3\alpha + 2\beta$. C. A. S.

4055. Resonance Levels of Nitrogen Excited by Rapid Neutrons. J. Thibaud and P. Comparat. *Comptes Rendus*, 206. pp. 226-228, July 18, 1938.—The numbers of α -particles thus ejected [see Abstract 3032 (1938)] are plotted against the energies $E_{\alpha, B}$. The curve thus obtained shows eleven maxima indicating resonance levels for $E_{\alpha, B} = 0.85, 1.02, 1.30, 1.60, 1.75, 2.05, 2.25, 2.55, 2.75, 3.05$, and 3.30×10^6 eV; these results agree fairly well with those of Wilhelm [see Abstract 602 (1938)], but are somewhat more detailed and more extensive. C. A. S.

4056. Angular Distribution of Resonance Disintegration Products. R. D. Myers. *Phys. Rev.* 54. pp. 361-367, Sept. 1, 1938.—For resonance symmetry considerations alone are found to give definite results on the angular distribution of the products of nuclear reactions. Formulae are developed for general coupling and Russell-Saunders coupling. It is found that the distribution is axially symmetric about the direction of the incident particle. It is also symmetric about the equatorial plane. The expression for the distribution is usually restricted to a small number of terms in an expression in spherical harmonics. These results are applied to the reactions: $D^2 + D^2 \rightarrow H^3 + H^3$; $B^{11} + H^1 \rightarrow Be^8 + He^4$, $Li^7 + H^1 \rightarrow 2He^4$, and $Li^6 + H^1 \rightarrow Li^7 + H^1$. For Russell-Saunders coupling the distribution for these reactions is uniquely determined by the assignment of the quantum number to the states involved. AUTHOR.

4057. Radioactive Cd. M. Dodé and B. Pontecorvo. *Comptes Rendus*, 207. pp. 287-289, July 25, 1938.—A description is given of radioactivity induced in Cd by bombardment with fast neutrons. The radiation emitted is very absorbable. It is suggested that the active element is an isotope of Cd; and that the radiation of low energy is emitted on decay of the excited nucleus through a metastable state. G. O. B.

4058. Radio-Silicon Produced by Bombardment of Sulphur with Rapid Neutrons. J. Cichocki and A. Soltan. *Comptes Rendus*, 207. pp. 423-425, Aug. 22, 1938.—Bombardment of S with neutrons of energy 13.5×10^6 eV produced by bombardment of Li with deuterons of energy 430 ekV, gives radioactive substances of periods 14.5 days and 2.6 hr., but no trace of that of period 26 min. [see Abstract 4243 (1937)]. That of period 2.6 hr. must be due to either ^{34}Si formed according to $^{32}\text{S} + \frac{1}{2}\text{n} \rightarrow ^{34}\text{Si} + \frac{4}{2}\text{He}$ (1), or to ^{33}P formed by $^{32}\text{S} + \frac{1}{2}\text{n} \rightarrow ^{33}\text{P} + \frac{1}{1}\text{H}$ (2). Chemical investigation is in favour of (1). This conclusion is supported by the fact that ^{34}Si formed from other sources has the period 2.6 hr. [see Abstract 3192 (1938)]. C. A. S.

4059. Artificial Radioactivity as a Test for Minute Traces of Elements. G. T. Seaborg and J. J. Livingood. *Am. Chem. Soc.*, J. 60. pp. 1784-1788, Aug., 1938.—It is shown how it is possible to detect and identify very small amounts of impurities by means of their characteristic half-lives, after the substance containing the impurities has been rendered radioactive by bombardment with charged particles of high energy or with neutrons. With the help of a chemical separation after the bombardment, impurities present to the order of 1 part in 10^6 can sometimes be detected. For example, a gallium impurity of six parts per million was found in a sample of iron. Impurities to the extent of 1 part in 10^3 to 10^4 can often be detected without subjecting the sample to chemical analysis.

AUTHORS.

4060. Re-Emission of α -Particles Absorbed by Light Nuclei. F. Perrin. *N. Cimento*, 15. pp. 189-192, March, 1938. *In French*.—To explain the experiments of Pawlowski, who found that some α -particles appeared in all directions after incidence on light nuclei, it is suggested that the α -particles are re-emitted after a period of absorption of about 10^{-12} sec. N. Bohr (*ibid.* p. 192) considers that the explanation presents serious difficulties. F. C. C.

4061. Observation of α -Rays on Irradiation of Th and U with Ra + Be-Neutrons. G. F. v. Droste. *Zeits. f. Physik*, 110. 1-2. pp. 84-94, 1938.—Investigations were undertaken on the basis of the observations made by Meitner, Hahn, and Strassmann [see Abstract 3314 (1937)] in order to test whether any observations could be made of the appearance of α -particles during the bombardment of U and Th by neutrons. An arrangement was used consisting of an ionisation chamber in connection with a re-duplicator with which it was possible to register individual α -rays in presence of almost 400 mg. Ra equivalent within 1.5 cm. distance from the measuring chamber with filtration through 1.5 cm. of W. Within a limit of error of ± 0.5 particles per min. there was in the case of U nothing found. This is in agreement with what is observed by chemical means. J. J. S.

4062. Disintegration of Po. M. Ferber. *Comptes Rendus*, 207. pp. 336-337, Aug. 1, 1938.—In a consideration of some records of α -particles from Po [see Abstract 1121 (1938)] a new method is employed which shows that there is a dependence in certain groups of disintegrations.

An expression is obtained for the total probability which suggests that a physical reality is concerned.

*4063. Neon Lamp as γ -Ray Counter. G. Lovera. *N. Cimento*, 15. pp. 145-148, March, 1938.—The possibilities of various commercial flashing neon lamps as recorders of β - and γ -rays are examined. The count-voltage curve is similar to that for a Geiger counter, showing a short region of constant sensitivity. The behaviour of Osram and Phillips lamps is compared and it is suggested that under certain circumstances such lamps may replace the ionisation chamber as current measuring instruments.

*4064. Intermittent Amplifier for Rapid Counting of Geiger-Müller Impulses. L. Kowarski and S. Winter. *J. de Physique et le Radium*, 9. pp. 251-258, June, 1938.—A reduction in the number of impulses reaching the recorder can be achieved by using an amplifier which is periodically inactive. Unfortunately the recorded fraction is subject to statistical fluctuations and the method is therefore less exact than the Wynn-Williams scale-of-eight amplifier. The apparatus is, however, simpler and more easily manipulated. It consists of a double counter amplifier of Rossi type and an oscillator of variable frequency. The recorder registers coincidences between a controlled fraction of the natural period and impulses received from the counter. The half-value period of radioactive Ag is found under various conditions to illustrate the flexibility of the apparatus.

*4065. H.F. Multiple Accelerators. E. O. Schlosser. *Zeits. f. techn. Physik*, 19. 8. pp. 237-240, 1938.—Mathematical examination of the variation of the efficiency of h.f. multiple accelerators under different conditions.

*4066. Transmutations and High Voltages. M. Pauthenier. *Soc. Franç. Élect.*, Bull. 8. pp. 687-706, Aug., 1938.—Review of the methods of producing and measuring high potentials, accompanied by a description of some of the results obtained on the artificial disintegration of the elements under high velocity positive ion bombardment.

*4067. D.C. Production at High Voltage. R. Planiol. *Comptes Rendus*, 207. pp. 323-324, Aug. 1, 1938.—Attempts are described at constructing a h.v. generator for the efficient acceleration of streams of ions [see Abstract 3703 (1937)]. Electrostatic machines having been rejected, and devices employing electron tubes not being sufficiently reliable or durable, rectifiers are examined for the purpose. A suitable copper-oxide rectifier gives 128 mA at 135 kV from a 150 kVA transformer.

*4068. Improved Ionisation Chamber for α - and H-Rays. J. Schintmeister. *Phys. Zeits.* 39. pp. 612-615, Aug. 15, 1938.—A description is given of an ionisation chamber for recording α - and H-rays, which is divided by a central grid into two sections. By means of this electrode, double recording of each ray is possible and thus the range and direction of the rays in the chamber can be ascertained for both α - and H-rays separately. A modified chamber with three electrodes is also described.

See also Abstracts 3965, 4255, 4256.

RADIATION.

ABSORPTION.

4069. Absorption of Light by Crystals. N. F. Mott. *Roy. Soc., Proc.* 167A. pp. 384-391, Sept. 6, 1938.—The mechanism of the absorption of light by solids is discussed from the theoretical point of view. The energy of a quantum of radiation can be converted into heat, re-emitted as fluorescent radiation, or used up in producing a photoelectric current within the solid; estimates are made of the dependence on temperature of the relative probabilities of these processes, which are compared with experiment. AUTHOR.

COLORIMETRY.

4070. Hue-Difference Sensitivity and Schrödinger's Theory. J. Rosemann. *Ann. d. Physik*, 32. 7. pp. 640-664, Aug., 1938.—Describes the results of an experimental investigation of the hue-difference sensitivity of the eye and compares these with the theory propounded by E. Schrödinger [see Abstract 856 (1921)]. Departures were found at the red end of the spectrum in contradistinction to the findings of A. Klughardt and M. Richter whose results showed departures at the blue end.

Author's view on the nature of color. J. W. T. W.

4071. Correlation of Colour Temperatures Based on the Wien and Planck Formulae. R. S. Estey. *J.O.S.A.* 28. pp. 293-295, Aug., 1938.—Gives a conversion table by means of which reciprocal temperatures on the Wien scale can be readily converted to the Planck basis for use in colorimetric computations. The relation is also shown in two diagrams, one giving the difference, plotted against Wien colour temperature, the other showing both scales plotted on the colour triangle.

J. W. T. W.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4072. Absolute Measurement of Kerr Constants with Alternating Potential. Y. Björnståhl. *Phys. Zeits.* 39. pp. 585-587, Aug. 1, 1938.—The relationship between the double refraction produced in a liquid by an alternating electric field and the Kerr constant is examined and discussed. It is shown that it is possible to carry out an absolute measurement of the Kerr constant with alternating potential; for this the validity of Talbot's law has to be assumed. J. E. K.

4073. Paramagnetic Rotatory Power of Hydrated Ethyl Sulphate of Nd in the Direction of the Optic Axis. J. Becquerel, W. J. de Haas and J. van den Handel. *K. Onnes Lab., Leiden, Comm. No. 244b. Physica*, 5. pp. 753-762, Aug., 1938. *In French.*—It is found that the hydrated ethyl sulphate of Nd obeys the same law as the corresponding compounds of Dy, Er and Pr [see Abstract 610 (1937)]. At liquid H_2 temperatures there is a second energy level. The thermomagnetic properties of the above ethyl sulphate are compared with those of the octohydrated sulphate. G. E. A.

4074. Magneto-Optical Activity of Crystalline $NiSO_4 \cdot 6H_2O$. F. G. Slack, R. T. Lageman and N. Underwood. *Phys. Rev.* 54. pp. 358-360, Sept. 1, 1938.—The dispersion of the Verdet constant of crystalline nickel sulphate α -hexahydrate has been measured through the visible spectrum. Temperature effect has also been investigated over

a narrow range of temperatures. All measurements are made with the light path parallel to the optic axis of the crystal. The magnetic rotatory dispersion curve may be fitted by a single term electronic dispersion equation as suggested by Drude. Calculation on this basis indicates an active absorption band at 964 Å. The Verdet constant is found to be inversely proportional to the absolute temperature, throughout the range measured. The Verdet constant for the sodium D line is 0.0221 min./oersted-cm. [See also Abstract 4107 (1938).] AUTHORS.

4075. Effect of Magnetic Field upon Mercury Discharge Radiation. V. Fabrikant and G. Rokhlin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 393-396, 1938. *In English.*—Application of a non-homogeneous magnetic field of moderate intensity to a low pressure Hg discharge results in a considerable increase in the intensity of the emitted radiation. The behaviour is attributed to longer electron paths which result in more molecular excitation. The effect on different spectral lines was examined in detail. As the increase in illumination rises more rapidly than the increase in power supplied to the lamp, the results may lead to a new method of increasing the light output of lamps. F. C. C.

EMISSION.

4076. Emission of Light-Quanta of Long Wave-Length. W. Pauli and M. Fierz. *N. Cimento*, 15. pp. 167-188, March, 1938. *In German.*—The problem of the deflection of a charged particle passing through a field of force is discussed by assuming a finite size for the particle. Although some of the difficulties of infinite energy are overcome, it is admitted that the calculations can hardly apply to actual electrons. G. C. McV.

***4077. Source of Mercury Resonance Radiation of High Intensity for Photochemical Purposes.** E. W. R. Steacie and N. W. F. Phillips. *Canad. J. of Research*, 16. Sect. B. pp. 219-221, July, 1938.—A lamp-reaction vessel system for photochemical purposes is described. This is very inexpensive and has an unusually high intensity of Hg resonance radiation (about 1.5×10^{-8} einstein per sec.). AUTHORS.

4078. Cosmic Rays and Nuclear Forces. I. Tamm. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 475-478, 1938. *In English.*—The possible transmutation of the mass of heavy electrons is examined theoretically and it is considered that such transmutation cannot occur in the absence of strong nuclear fields. Reasons are given for believing that the change heavy electron $\rightarrow$ ordinary electron is reversible. F. C. C.

4079. Heavy Electrons in Cosmic Rays. V. Veksler and N. Dobrotn. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 479-482, 1938. *In English.*—Using two groups of five proportional counters located one inside the other, a marked decrease was observed in the number of coincidences when an iron plate was placed between them. The behaviour is attributed to heavy electrons produced by the interaction of cosmic rays with matter. F. C. C.

4080. Earth's Magnetic Field and Cosmic Radiation. V. F. Hess, A. Demmelmaier and R. Steinmaurer. *Akad. Wiss. Wien, Ber.* 147. 2a. 3-4. pp. 89-100, 1938.—Cosmic-ray ionisation records taken on the Hafelekar in 1936-7 show the following correlations between cosmic-ray intensity and the strength of the earth's horizontal magnetic component: (a) the daily mean cosmic-ray intensity varies in the same

direction as does the field during magnetic disturbances, but often at other times as well; (b) more generally the variations of the daily mean cosmic-ray intensity are in the opposite direction to variations of the field when long periods are considered; (c) the mean variation in the course of the day is in the opposite direction to the field strength variation; (d) the seasonal variation is in the opposite direction to that of the field. The first three effects are explained in terms of Chapman's hypothesis of extra-terrestrial currents encircling the earth. D. H. F.

4081. Absorption of Penetrating Component of Cosmic Radiation. W. M. Nielsen and K. Z. Morgan. *Phys. Rev.* 54, pp. 245-248, Aug. 15, 1938.—Measurements of the absorption of cosmic radiation by Pb in thicknesses up to 550 gm./cm², were made by means of counters in a rock cavern at a depth of approximately 60 m. water equivalent. Comparison with measurements taken outside the cavern showed a hardening of the penetrating component after passing through the rock. The percentage of soft radiation inside and outside the cavern is about the same in the two cases (25-30%). It is considered that it is unnecessary to assume the transmission of cosmic-ray energy to these large depths by non-ionising particles, such as neutrinos. The character of the absorption curve for the soft component under a depth of 60 m. water equivalent shows that it must be possible for the penetrating component to generate secondaries of considerable energy. D. H. F.

4082. Residual Currents and Deep Water Measurements of Cosmic Rays. S. Szczeniowski and S. Ziemecki. *Acta Physica Polonica*, 7, 1, pp. 59-67, 1938. *In English*.—Residual currents in two ionisation chambers, one filled with A, the other with air, at pressures up to 30 atm., have been measured in a rock-salt mine at a depth of 406 m. The residual current diminished with diminishing pressure. Very marked fluctuations, sometimes several times the mean value, were observed. It is considered that this and some of the other observed details can perhaps be explained by the hypothesis of an emission of positive particles, of an unspecified nature, from the walls of the chamber. It is considered that these findings have a bearing on the contradictory and anomalous results found by other investigators under great depths of water. D. H. F.

4083. Large Atmospheric Cosmic-Ray Showers. P. Auger and R. Maze. *Comptes Rendus*, 207, pp. 228-230, July 18, 1938.—Further experiments with widely separated counters have shown that the large showers of penetrating particles previously reported [see Abstract 3212 (1938)] may cover an area of 1000 m², and consist of several tens of thousands of particles, of which about one-half are able to penetrate 5 cm. of Pb. Such showers would require the energy of the particle producing it to be about 10¹² or 10¹³ eV. The significance of these results in relation to certain other cosmic-ray phenomena is briefly pointed out. D. H. F.

4084. Cosmic-Ray Showers under 30 m. of Clay. J. D. Crawshaw. *Phys. Soc. Proc.* 50, pp. 783-787, Sept. 1, 1938.—The vertical intensity of the cosmic radiation and of the cosmic-ray shower-intensity have been measured at ground level and at a station 30 m. below the surface, and the ratio of these two quantities has been shown to be nearly the same at the two levels. A transition curve in lead has been obtained at the Holborn Underground station and its shape differs widely from the typical curve obtained at sea level. After a sharp initial rise, the shower-rate remains stationary for thickness of lead up to 8.8 cm., in contrast to the

rapid decrease which occurs after the maximum at sea level. The curves obtained underground are shown to be very similar to those obtained by Drigo at sea level under about 2 m. of masonry. AUTHOR.

4085. Shower Frequency and Cosmic-Ray Intensity. L. Jánossy. *Roy. Soc., Proc.* 167A. pp. 499-508, Sept. 23, 1938.—The frequency of cosmic-ray showers was observed at sea-level and under 30 m. of clay (60 m. of water equivalent). The shower frequencies at the two levels were compared with the corresponding vertical intensities. Part of the experiments were carried out with layers of light material close above the lead in order to maintain similar geometrical conditions for the shower production at both levels. The marked observed effect of the stone on the transition curve can be understood as due mainly to the spatial association of the shower-producing electrons emerging from the stone, rather than to filtration. The relative shower intensity, i.e., (shower frequency/vertical intensity), of the showers producing the first slope of the transition curve was found to be nearly the same at sea-level and underground; on the other hand, the shower frequency due to showers producing the tail of the transition curve increases relatively with depth. The conclusion was drawn that most of the showers at sea-level and underground are due to secondaries of some kind produced by the penetrating particles, and that consequently relatively few can be due to primary electrons.

AUTHOR.

4086. Transition Effects of Cosmic Rays in the Atmosphere. R. Serber. *Phys. Rev.* 54. pp. 317-320, Sept. 1, 1938.—The calculation of the multiplication of the soft component of the cosmic rays in the upper atmosphere is refined by use of the exact high energy radiative formulae of Bethe and Heitler, and the resulting diffusion equations are solved by the method of Snyder. Comparison with the vertical counter work of Plotzer, and of Carmichael and Dymond, and with the ionisation chamber data of Bowen, Millikan, and Neher, shows that the calculated position of the maximum of the multiplication curve is now in good agreement with that observed. The latter comparison also indicates that the penetrating component is at least largely of secondary origin. AUTHOR.

See also Abstracts 3995, 4093.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4087. Powerful Fluorescence of Calcareous Minerals. M. Dérivé. *Comptes Rendus*, 207. pp. 222-223, July 18, 1938.—Many calcareous minerals have been found to show a powerful luminescence in Wood-filtered u.v. light which persists in some cases for several seconds. Temperature appears to have no effect in many cases, but the hydrated minerals lose their phosphorescent power when water of inclusion is driven off. The time decay curves are exponential. J. E.

4088. Colour and Fluorescence of Dyestuffs. B. Bugyi. *Kolloid Zeits.* 84. pp. 74-84, July, 1938.—The colour and fluorescence of some 40 dyestuffs under different conditions (solid, neutral solution, acid and alkaline solution, alcoholic and aqueous solutions and in capillary adsorption) and under excitation by daylight and filtered Hg light, have been examined. The colour and fluorescence show in general marked differences in the various states. Some possible interpretations of the differences are mentioned. Three tables are given showing the colours and fluorescence of the dyestuffs investigated. J. E.

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4089. Fluorescence and Photodecomposition of Acetone Vapour. M. S. Matheson and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 60. pp. 1857-1864, Aug., 1938.—An apparatus for studying the fluorescence of gases is described. The ratio of absorbed to fluorescent intensity of acetone is a function both of incident intensity and of time of exposure. Only at very low intensities is a Stern-Volmer equation obeyed. The fluorescence spectra of acetone and of biacetyl are identical at wave-lengths longer than 5000 Å. The fluorescence in the blue, which alone appears when O_2 is present, is much weaker than the fluorescence at longer wave-lengths and could not be photographed. Small amounts of biacetyl greatly increase the fluorescence of acetone. It is concluded that the fluorescent emitters are the same for both acetone and biacetyl, at least as regards the bands at 5000 Å and longer wave-lengths. Mechanisms to account for these facts are advanced. An adequate explanation is based on a very probable deactivation of excited acetone molecules by biacetyl, the excited biacetyl being responsible for the fluorescence. However, fluorescence of the CH_3CO radical cannot be excluded. AUTHORS.

4090. Fluorescent Ion of Chromium in Ruby. B. V. Thosar. *Phil. Mag.* 26. pp. 380-389, Sept., 1938.—The Zeeman pattern of the red fluorescence doublet of ruby at $-180^\circ C.$ has been explained on the supposition that the fluorescent Cr^{++} ions enter the crystal lattice of Al_2O_3 , substituting in places the Al-ions, and that it is the spin-moment only and not the orbital moment that responds to the magnetic field. This is shown to be in entire agreement with the theory of paramagnetism of the ions of the transition series, as developed by Bose, Stoner, and others. Taking the Landé factor $g = 2$, the calculated Zeeman interval is shown to be of the same order of magnitude as the observed one, but numerically different. A possible explanation of this disagreement and of the asymmetry of the pattern has been indicated. Reasons for the difference in intensity of the red doublet for ruby and sapphire and in their colour have been offered. The curiously great intensity of this forbidden doublet has also been explained. AUTHOR.

4091. Fluorescence in a Layer of Thickness Comparable to Wave-Lengths. Part II. F. S. Baryšanskaja. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 465-468, 1938. *In French.*—A continuation of previous work [see Abstract 647 (1938)]. Results are given for solutions of fluorescein in water and in glycerin illuminated obliquely and observed from above and obliquely. J. E.

4092. Polarisation of Band Fluorescence of Metal Vapours. S. Mrozowski. *Acta Physica Polonica*, 7. 1. pp. 45-48, 1938. *In German.*—The degree of polarisation of Te and of Se vapours excited by Hg 4358 Å has been determined. Agreement is found with the calculations based on Placzek's formula. J. E.

4093. Luminescent Materials and Application to Light Sources. J. W. Ryde. *Illum. Eng. Soc. (London), Trans.* 3. pp. 114-125; *Disc.*, 125-128, Aug., 1938.—After an historical survey of the subject the author briefly describes the various forms of luminescence, viz., chemi-luminescence, bio-luminescence, flame luminescence of solids and photo-luminescence. In the final category he deals with organic substances, pure inorganic compounds and, finally, activated inorganic substances. The effects of various metals as activators are described and the modifications of colour which can be produced by a change of proportions in a suitable mixture are mentioned. In the final section of the paper, the

conditions to be satisfied by a substance to be used in conjunction with a discharge lamp are listed and the developments now proceeding in the production of practical lamps depending on luminescence are briefly referred to. Finally, a table of luminous efficiencies of various types (in lumens/W) is given. The values range from 15 (pale blue or pink) to 60 (bright green). In the *Discussion*, J. T. Anderson referred to the activation of inorganic substances by organic compounds. The author stated that in the case of inorganic compounds deterioration was due to a chemical change and could be prevented by incorporating the material in a suitable medium. This did not apply in the case of the fluorescent organic dyes.

J. W. T. W.

4094. Fluorometer. O. Maercks. *Zeits. f. Physik*, 109, 11-12, pp. 685-699, 1938.—Two fluorometer arrangements are described in which stationary supersonic waves are used to interrupt the light. The exciting light passes through a trough in which it is modulated by supersonic stationary waves and is then concentrated on to the cell containing the fluorescent liquid. The fluorescent light scattered at right angles to the direction of the exciting light is led back by a lens and prism through the first trough in a direction crossing the exciting beam at right angles, falling finally on a differential photo-cell. If the decay time were infinitesimal the effect on the photo-cell would be a maximum when the amplitude of the supersonic wave is a minimum but with a finite decay time the fluorescent light is retarded by the mean decay time and reaches the first cell again when the supersonic wave has an amplitude which is no longer zero. The fluorescent light passing through the first cell is thus diffracted and the photo-cell gives a smaller reading. To find the decay time the cell containing the fluorescent liquid is replaced by a half-silvered plate. The exciting light is then passed through this and on to a prism which reflects it back again. The distance of the reflecting prism is varied till the reading of the photo-cell is the same as with the liquid in place. Then the time taken for the light to pass from half-silvered plate to reflecting prism and back is equal to the mean decay time. In a second arrangement the time of decay is determined by comparing the appearance of a stroboscopic disc when illuminated first by the modulated exciting light and then by the modulated and delayed fluorescent light. The limits of error of the methods are considered to be of the order $\pm 0.2 \times 10^{-9}$.

J. E.

See also Abstract 4147.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4095. Distribution of Intensity in Interference Fringes. J. Roig. *J. de Physique et le Radium*, 9, pp. 241-244, June, 1938.—A method is described for separating the width of the fringe due to the line width from that due to the apparatus in the case in which the former is large (line widened by the Doppler effect) and the effect of the latter is small (a large path difference).

H. G. C.

See also Abstracts 3937, 3964, 4110, 4182, 4183, 4202.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4096. Photochemical Decomposition of N_2O . F. C. Henriques, Jr., A. B. F. Duncan and W. A. Noyes, Jr. *J. Chem. Phys.* 6, pp. 518-522, Sept., 1938.—O atoms were produced in $NO_2 - N_2O$ mixtures
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by the photo-decomposition of NO_2 alone. No reaction of these atoms with N_2O could be detected. Results of calculations give a minimum activation energy of 14,000 cal. for the reaction $\text{O} + \text{N}_2\text{O} = 2 \text{NO}$ and a probable maximum activation energy of 24,000 cal. The activation energy of the reaction $\text{O} + \text{NO}_2 = \text{NO} + \text{O}_2$ is estimated to be 4000 cal. It is concluded that two primary processes are necessary to explain the direct photo-decomposition of N_2O , $\text{N}_2\text{O} + h\nu = \text{N}_2 + \text{O}$ and $\text{N}_2\text{O} + h\nu = \text{NO} + \text{N}$. The latter reaction must be followed by $\text{N} + \text{N}_2\text{O} = \text{NO} + \text{N}_2$ to explain previously determined quantum yields. The energy of activation of this reaction is probably less than 10,000 cal. [See Abstract 4938 (1937).] AUTHORS.

4097. Photochemical Primary Process of Ions in Aqueous Solution. A. Farkas and L. Farkas. *Faraday Soc., Trans.* 34, pp. 1113-1120, Sept., 1938.—It is shown, on the basis of energetic considerations, that the present interpretation of the electron affinity spectra has to be modified. It is suggested that the process occurring in the absorption of light is the transfer of an electron from the ion to the water molecule in the hydration layer. From this intermediate state the electron can either return to its initial state when no photochemical change is to be observed, or can pass over to the final state resulting in a chemical reaction. In the reaction of negative ions, the final state is reached by the transfer of the electron to a positive ion. For the iodine ion this mechanism is formulated as $(\text{I}^- \cdot \text{H}_2\text{O}) + h\nu \rightleftharpoons \text{I} \cdot \text{H}_2\text{O}^-$; $\text{I} \cdot \text{H}_2\text{O}^- + (\text{H}^+) \rightarrow \text{I} + \text{H}_2\text{O} + \text{H}$. The energy of the absorbed radiation is given by $h\nu = E + H - E_{\text{H}_2\text{O}}$, where E is the electron affinity of the I atom, H the energy of hydration of the iodine ion and $E_{\text{H}_2\text{O}}$ the electron affinity of water (about 18 cal.). It is shown that this mechanism accounts for the relative position of the absorption spectra of the halogen ions and for the dependence of the photochemical quantum efficiency on concentration and acidity. For the SO_3^{2-} ion essentially the same equations are valid but the energy level of the intermediate state is lowered by the residual polarisation of the water molecules around the SO_3^{2-} ion. For the ferrous ion the primary process is also the transfer of an electron to a water molecule in the hydration layer; the photochemical change occurs when the $(\text{Fe}^{++} \cdot \text{H}_2\text{O}^-)$ complex of the intermediate state decomposes into $(\text{Fe}^{++} - \text{OH}) + \text{H}$. AUTHORS.

4098. Separation of Hydrogen Isotopes in Photochemical Liberation from Aqueous Solutions. A. Farkas and L. Farkas. *Faraday Soc., Trans.* 34, pp. 1120-1127, Sept., 1938.—The separation of the H isotopes occurring in the photochemical liberation of H from aqueous solutions of iodide, sulphite and ferrous ions has been investigated. In solutions containing 15-78% of D the following separation factors were observed: for acidulated iodide, 3.7-6.6; for sulphite, 10.6; for ferrous ion, 3.8-4.8. The possible causes of the separation are discussed and it is suggested that the separation occurs in the photochemical process, a H atom having about four times greater probability of being formed than a D atom. The dependence of the separation factor on the concentration of D in the case of the iodide ion is attributed to the relative distribution of H and D atoms in the hydroxonium ions. The high separation factor for the sulphite ion is apparently partly caused by the isotopic effect in the heat of hydration of the sodium ion and partly by secondary reactions. AUTHORS.

4099. Chemical Reactivity. H. W. Melville. *Roy. Inst., Proc.* 30. 2. pp. 358-377, 1938.—The author discusses present ideas concerning the nature and mechanism of chemical reactions, limited, however, to gas reactions. Variation in rate of reaction is first considered and the reason for chemical inertia explained. This involves consideration of the 4 classes of activated molecules: (a) Those in which one or more of the electrons have been excited to a higher energy level; those possessing (b) translational, (c) vibrational, and (d) rotational energy in excess of the mean value. In the two latter classes the energy may be so large that the molecules are dissociated to free atoms or radicals. The explanations are accompanied by very complete descriptions of experimental illustrations. Work with atomic H receives special attention and associated therewith is the production of CH and C₂ molecules. A device is also shown for the measurement of the lifetime of fluorescence decay. The photochemical method of producing activated molecules and so inducing reaction to occur is shown to have the great merit that the conditions in the system may be changed independently of the source of excitation. This measure of control is much used in unravelling complex reactions when a whole series of consecutive processes have to be separated into their components, e.g., polymerisation of simple molecules to synthetic resins, rubbers, etc. An Appendix deals with the construction of a potential energy model.

H. H. Ho.

4100. Rapid Development and Fixing of Photographic Negatives. A. Charriou and S. Valette. *Soc. Franç. Phot. et Cind., Bull.* 25. pp. 125-131, Aug., 1938.—Briefly examines the results obtained from 16 developing and 11 fixing solutions, considering the choice of the best solutions, and the practical applications. Solutions, and methods of treatment, are given which will give a negative in approximately 90 sec. at 20° C. with normal emulsions, or in 35 sec. at 50° C. with certain special emulsions.

R. C. F.

4101. Theory of Additive Three-Colour Photography. A. C. Hardy. *Phot. J.* 78. p. 546, Aug., 1938.—A brief note continuing the discussion on the paper by Harrison and Horner [see Abstract 3226 (1938)].

R. C. F.

See also Abstracts 4077, 4089.

PHOTOMETRY.

4102. Tungsten, Mercury and Sodium Illuminants at Low Brightness Levels. M. Luckiesh and A. H. Taylor. *J.O.S.A.* 28. pp. 237-240, July, 1938.—Photometric brightness matches between W filament light and Na or Hg light were made at different brightness levels and with different sizes of the photometric field. The results were in general agreement with expectations from the Purkinje effect. Other measurements of the smallest perceptible contrast for the three illuminants appeared to show that the greater loss of brightness with Na light at low brightness levels is fully compensated for by an increased sensitivity to threshold stimulus (energy density) difference.

W. S. S.

4103. Microphotometer. E. E. Berkley and O. C. Woodyard. *Indust. and Engin. Chem. (Analytical Edition)*, 10. pp. 451-455, Aug. 15, 1938.—Describes the construction, method of use, and results obtained with a new microphotometer developed for the measurement of X-ray diffraction patterns, and used with diffraction patterns of raw cotton fibres. The photometer consists of a constant light source focused on the

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pattern, a measuring device composed of a photo-cell and a galvanometer system, and a compound mechanical stage for holding and moving the patterns under the light beam while measuring them. The instrument is stable, and shows a high degree of precision in repeated measurements, particularly if the patterns are for samples under tension when their Chandler strengths can also be obtained. R. C. F.

POLARISATION.

4104. Temperature Dependence of the Degree of Depolarisation of Gaseous CO_2 , N_2O and C_2H_2 . R. Schmidt. *Phys. Zeits.* 39, pp. 574-580, Aug. 1, 1938.—The dependence of the degree of depolarisation of gaseous CO_2 , N_2O and C_2H_2 on temperature is measured by the usual cross-tube method. Convergent light is used and the results are obtained by photometric evaluation of photographic records; the temperatures at which records are taken are 20, 40, 60 and 85°C . For temperature changes of about 30% of the absolute temperature there is no change in the degree of depolarisation within the limits of experimental error of $\pm 5\%$. J. E. K.

4105. Rotatory Power of Quartz in the Far Ultra-Violet and in the Schumann Region. R. Servant. *Comptes Rendus*, 207, pp. 283-285, July 25, 1938.—The study of the rotatory power, ρ , of quartz is extended beyond 1854Å into the Schumann region, where an enormous increase in ρ is found. Concordant results are obtained which allow the construction of the dispersion curve. Comparison of experimental results with those obtained from the two existing formulae indicate that the formulae appear to be inadequate. W. R. A.

4106. Rotatory Dispersion in the Amine Series. Part IV. W. C. G. Baldwin. *Roy. Soc., Proc.* 167A, pp. 539-554, Sept. 23, 1938.—Variations in Drude equations for the rotatory dispersions, and changes in specific rotation, which occur on neutralisation, are utilised for the detection of induced dissymmetry in the amino-radical of optically active bases. When the lone pair of electrons of the N-atoms becomes bound in any way, the partial rotation associated with it disappears. An attempt is made to explain the behaviour of a few exceptional bases whose rotatory powers contain no contribution which can be attributed directly to the lone pair of electrons. Such bases do not give the large alteration in specific rotation which is usually produced by ionisation. The rotatory dispersion of crystalline ethylene-diamine sulphate is compared with that of *l*-propylene-diamine, *l*-diamino-cyclohexane, and of their salts in solution. Measurements and analyses are given for these two optically active bases, as well as for their mono- and di-hydrochlorides. The results are interpreted in terms of Boys' molecular model, and the absolute configuration of *l*-propylenediamine is defined. In spite of statements in the literature to the contrary, the sign of the specific rotation of this base is actually reversed on ionisation, and this experimental fact constitutes strong evidence in favour of the proposed model. It is shown that the major contribution to the optical activity of *l*-propylenediamine may be attributed to the absorption bands associated with the two lone pairs of electrons in the molecule. Assuming the presence of an unchanging dextro-rotatory nucleus common to all three ionic forms, an attempt is made to estimate the other contributions to the rotatory power and dispersion is made. The absorption bands between 2300 and 2000Å which are without exception common to all amines previously investigated are in

the cases of *l*-propylenediamine and *l*-cyclohexane not optically active. The induced dissymmetry is centred at wave-lengths between 1900 and 1400 Å, and is associated with two groups of absorption bands in this region, one due to the lone pairs of electrons, and the other to the more saturated CN and NH linkages. [For Parts I-III see Abstract 4495 (1937).] AUTHOR.

4107. Optical Activity of Crystalline NISO₄ · α-6H₂O. N. Underwood, F. G. Slack and E. B. Nelson. *Phys. Rev.* 54. pp. 355-357, Sept. 1, 1938.—The optical activity of crystalline nickel sulphate α-hexahydrate has been measured throughout the visible portion of the spectrum. The observations are extended near to absorption regions by an adaptation of the method of Fizeau and Foucault. Both right- and left-hand crystals are found and the rotatory dispersion curves show anomalous rotatory dispersion. By application of Drude's equation, in which two terms are used, the observed anomaly is predicted as due to absorption bands lying at 3954 Å and 7187 Å, respectively. Transmission data for the crystal show the presence of these two bands, in agreement with previous absorption data for solutions of the material. [See also Abstract 4074 (1938).] AUTHORS.

See also Abstract 4092.

REFLECTION, REFRACTION AND DISPERSION.

4108. Reflection Factor of Clothing. P. Moon and M. S. Cettel. *J.O.S.A.* 28. pp. 277-279, Aug., 1938.—Gives the results of a survey of the reflection factors of a large number of samples of men's clothing. Over 200 samples were measured spectrophotometrically and the reflection factors were calculated for illumination by tungsten filament, mercury and sodium lamps. The tones were, on the average, very neutral so that no considerable difference was found for the three illuminants. Excluding white materials, the range of reflection factors for overcoats and suits was found to be 1.6 to 18%. J. W. T. W.

4109. Experimental Determination of the Optical Constants of Metals. J. B. Nathanson. *J.O.S.A.* 28. pp. 300-310, Aug., 1938.—An outline is given of the general experimental methods used, and the results that have been obtained, in the study of the optical properties of bulk metals. A. H.

4110. Determination of Optical Constants by the Optical Pyrometer. A. G. Worthing. *J.O.S.A.* 28. pp. 311-312, Aug., 1938.—No new results are presented in this paper which is confined to a discussion of the special features relating to the method. A. H.

4111. Optical Properties of Alkali Metals. R. W. Wood and C. Lukens. *Phys. Rev.* 54. pp. 332-337, Sept. 1, 1938.—The physical processes responsible for the unique optical properties of Ag, in contrast to those of the alkali metals are briefly discussed from the standpoint of the zone theory of electron distribution in crystals. The results of experiments undertaken in the hope of finding a renewal of reflecting power in the remote u.v. in the case of the alkali metals, are recorded. Photographs of the spectra of the discharge of a condenser through a capillary tube after reflection from metal films condensed at liquid-air temperature showed no return of reflection in the region extending down to 500 Å. AUTHORS.

4112. Refractive Indices of Liquid He I and He II. H. E. Johns and J. O. Wilhelm. *Canad. J. of Research*, 16. Sect. A. pp. 131-132, July, 1938.—The refractive indices of liquid He I and He II were measured by

means of a Wollaston cell. (The value obtained with 5461 Å for He I at 4.2° K. was 1.0206 ± 0.0012 ; for He I at 2.26° K., 1.0269 ± 0.0004 ; and for He II at 2.18° K., 1.0269 ± 0.0004 . It was also shown that the index changed by less than ± 0.00007 in passing from a point in He I to a point with the same density in He II. It is concluded, therefore, that there is no change in the molecular refractivity in passing from He I to He II.)

AUTHORS.

4113. Ray-Surface and Optical Indicatrix. G. Tunell. *Washington Acad. Sci.*, J. 28, p. 345, Aug. 15, 1938.—A correction [see Abstract 4082 (1933)].

See also Abstracts 3941, 3953, 4131.

SPECTROSCOPY.

4114. Quantitative Analysis Based on Spectral Energy. M. Slavin. *Indust. and Engin. Chem. (Analytical Edition)*, 10, pp. 407-411, Aug. 15, 1938.—An explanation is given for certain limitations of the commonly used internal standard method, and energy of spectral emission is suggested for measurement of concentration in place of intensity. Experimental work shows that the energy of spectral emission in a carbon arc is directly proportional to the weight of element causing the emission. For quantitative analysis, therefore, it is only necessary to determine energy per unit weight of element on known samples, and apply this value in the analysis of unknowns. This procedure permits working over the entire range from the lowest limit of sensitivity up to 100%. The presence of other elements appears to have no effect on the analysis. The average error was found to be 8.3% and the maximum error was 18.5%.

AUTHORS.

4115. Probable Existence of Element 93 in Natural State. H. Hulubel and Y. Cauchols. *Comptes Rendus*, 207, pp. 333-335, Aug. 1, 1938.—Minerals containing U or Re were treated chemically by a method calculated to concentrate any Element 93 that might be present and then examined spectrographically for the lines indicated by Moseley's theory as those of that element. In this way evidence in support of the probable presence of four of these lines was obtained, and therefore of the probable presence of 93 in quantity sufficient for spectrographic detection, and perhaps even for chemical concentration.

C. A. S.

4116. Interferometric Wave-Length Comparison of the Red Cadmium Radiation Emitted by Different Sources. W. E. Williams and D. V. Gogate. *Roy. Soc., Proc.* 167A, pp. 509-516, Sept. 23, 1938.—A comparison is made between the wave-lengths of the red Cd line 8438 Å emitted by a G.E.C. Osira Cd lamp and a Schüller hollow-cathode discharge by photographing the Fabry-Pérot fringes due to the two sources side by side in the same horizontal plane by means of a specially designed plate-holder. Interferometer gaps up to 10 cm. were used, and the greatest difference recorded was less than 1 part in 100×10^4 or 0.00006 Å.

AUTHORS.

4117. New Terms in Spectrum of Na III. D. H. Tomboullian. *Phys. Rev.* 54, pp. 347-350, Sept. 1, 1938.—The spectrum of Na III has been excited by an electrodeless discharge. Wave-length measurements have been made in the region from 500 to 2600 Å. On the basis of these determinations it has been possible to establish 30 new levels arising from the $2s^2 2p^4 3p$, $2s^2 2p^4 3d$, and $2s^2 2p^4 4s$ configurations.

AUTHOR.

4118. Spectra of Rb III and Sr IV. D. H. Tomboullan. *Phys. Rev.* 54. pp. 350-354, Sept. 1, 1938.—By applying Shortley's equations to the $4s^2 4p^5 ({}^2P^o)$ $5p$ levels of Rb II, the separation of the ground levels $4s^2 4p^5 {}^2P^o$ of Rb III has been computed, and experimentally observed to be 7380 cm^{-1} . In the case of Sr IV, the ${}^2P^o$ separation has been predicted from the regular doublet law and identified from the data as 9731 cm^{-1} . On the basis of transitions into the ground doublet certain $4s^2 4p^4 d$ and $4s^2 4p^4 f$ levels have been located.

4119. Broadening and Displacement of Higher Series Lines of Sodium by Cs-Vapour. C. Fuchtbauer and G. Helmann. *Zeits. f. Physik*, 110. 1-2. pp. 8-20, 1938.—Measurements are made of the broadening and displacement of Na lines due to admixture of Cs in the discharge; the measurements of broadening are made on the lines $1s-9p$ to $1s-12p$ of the principal series and the displacement measurements on lines $1s-9p$ to $1s-20p$. Extremely large broadenings are recorded equal to those of Cs lines produced by Cs; the displacements follow the same trend in the series as those produced by A. The effective cross-section of Cs atoms for slow electrons calculated from the displacement is $25.9 \times 10^3 \text{ cm}^2/\text{cm}^3$; this compares with $1.1 \times 10^3 \text{ cm}^2/\text{cm}^3$ measured by an electrical method by Brode for electrons of $0.8\sqrt{\text{volt}}$ velocity.

J. E. K.

4120. Hyperfine Structure of B, Y, Rh and Pd. D. T. Williams and L. P. Granath. *Phys. Rev.* 54. pp. 338-341, Sept. 1, 1938.—The spectra of B, Y, Rh and Pd excited in an uncooled Schüller lamp, were investigated in the region $\lambda\lambda 2500-4000$ with a 20-cm. quartz Lummer-Gehrcke plate, in an attempt to find hyperfine structure. None was discovered that could be interpreted either as isotope shift, or as structure due to a nuclear magnetic moment.

AUTHORS.

4121. Nuclear Magnetic Moment of Copper. S. Tolansky and G. O. Forester. *Phys. Soc., Proc.* 50. pp. 826-833, Sept. 1, 1938.—The doublet hyperfine structures of the resonance lines of the Cu arc spectrum, $\lambda 3247$ and $\lambda 3274$, have been measured with a quartz Lummer plate. The lines are produced free from reversal effects, the doublet separations being respectively 379 and $405 \times 10^{-3} \text{ cm}^{-1}$. The following hyperfine structure interval factors are calculated. $3d^{10} 4s^2 S_1 = 197.5$, $3d^{10} 4p^2 P_1 = 14$ and $3d^{10} 4p^2 P_{11} = 4.8$ (all in $\text{cm}^{-1} \times 10^{-3}$). The mean nuclear magnetic moment for the two Cu isotopes, 63 and 65, is derived from the ground state, $3d^{10} 4s^2 S_1$. The value found is $\mu = 2.47$ nuclear magnetons, this being probably a better estimate than that given by other terms, since the ground state is spherically symmetrical and thus not affected by quadrupole moment of the nucleus. By adopting Schüller and Schmidt's value for the ratio of the magnetic moments of the two isotopes, it is found that $\mu ({}^{63}\text{Cu}) = 2.43$ and $\mu ({}^{65}\text{Cu}) = 2.54$ nuclear magnetons.

AUTHOR.

4122. Atomic Energies for Configurations Containing Almost Closed Shells. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 20. pp. 478-483, June, 1938.—A vector-model method is given for calculating the energy expression for an atom or ion comprising a core with an almost complete shell in a definite multiplet state to which one inequivalent electron is added. Some simple interval rules for the terms of highest multiplicity arising from configurations containing p and d electrons are derived and are tested by comparison with experimental values. The method can be generalised for the cases in which the core contains other electrons besides

the almost closed shell or more than two electrons are added to the core.

4123. Lower Limit for Theoretical Energy of Normal State of Helium. A. F. Stevenson and M. F. Crawford. *Phys. Rev.* 54. pp. 375-379, Sept. 1, 1938.—The method of using a modification of Weinstein's lower limit for the energy, as given recently by one of the authors [*ibid.* 53, p. 199, Jan. 15, 1938] has been applied to the normal state of He, with the same sequence of functions as was employed by Hylleraas in his upper limit calculations. The ninth approximation leads to the lower limit —1.45508 Hylleraas units, which can very probably be increased to —1.45446, whereas the upper limit found by Hylleraas is —1.45187. The bearing of the results found on the probable location of the true eigenvalue is discussed, as is also the applicability of the method in general.

4124. Absorption Spectra of Cis- and Trans-Isomers in the Near Infra-Red. Yeou Ta. *Comptes Rendus*, 207, pp. 326-329, Aug. 1, 1938.—An extension of work already noted [see Abstract 3251 (1938)].

4125. Infra-Red Absorption Spectrum of H_2O_2 . C. R. Bailey and R. R. Gordon. *Faraday Soc., Trans.* 34, pp. 1133-1138, Sept., 1938.—The infra-red spectrum of H_2O_2 has been examined partly in the liquid, and partly in the gaseous state. In spite of considerably experimental difficulties sufficient bands have been identified to enable reasonable assignments to be made with the help of the Raman spectrum. The spectra are in accordance with the C_2 model suggested by Penney and Sutherland.

4126. Inner Rotation and Normal Vibrations of Ethane. Part III. K. Schäfer. Part IV. J. Goubeau and J. Karwell. Part V. J. Karwell and K. Schäfer. *Zeits. f. phys. Chem.* 40, Abt. B. 5, pp. 357-390 and 396, 1938.—In Part III an accurate calculation is given of the entropy and molecular specific heat of C_2H_6 by treating the molecule as a symmetrical top with hindered inner rotation. Schäfer shows that there are 9 modifications of C_2H_6 which do not intercombine and calculates the entropy of this mixture of 9 forms. A comparison with Hunsman's results for the molecular specific heat in Part II [see Abstract 2031 (1938)] and Kemp and Pitzer's values for the entropy [see Abstract 1743 (1937)] shows that the energy of the hindered inner rotation is approximately 3000 cal. This energy value leads to a corresponding torsional vibration of 1130 cm^{-1} . In Parts I and II of the publication this vibration had been assigned to the frequency 740 cm^{-1} . In Part IV a new determination is made of the Raman-spectrum of liquid C_2H_6 . In Part V it is shown that it is possible to interpret the infra-red and Raman-bands of C_2H_6 by substituting the frequency 1140 cm^{-1} for the 740 cm^{-1} fundamental. The fundamentals, overtones and combination tones of C_2H_6 are tabulated under the assumption that the molecule belongs to the symmetry class D_{3h} .

4127. Vibrational Spectrum and Thermodynamic Properties of Nickel Carbonyl. B. L. Crawford, Jr., and P. C. Cross. *J. Chem. Phys.* 6, pp. 525-530, Sept., 1938.—The infra-red absorption spectrum of nickel carbonyl has been measured in the gas phase from 4 to 23μ , and in the liquid phase from 1 to 8μ . Normal coordinate treatments of both the square and tetrahedral models of the AB_3C_4 molecule have been applied to the infra-red and Raman data; the results give further evidence of

the tetrahedral structure of nickel carbonyl. An analysis of the vibrational spectrum has been made, based on the tetrahedral model, and has been applied to the statistical calculation of the entropy, heat capacity, and free energy function. AUTHORS.

4128. Vibration Spectra and Molecular Structure. Part IV. Infra-Red Absorption Spectra of Double and Single Molecules of Formic Acid. L. G. Bonner and R. Hofstadter. *J. Chem. Phys.* 6. pp. 531-534, Sept., 1938.—In the present study the absorption spectrum of formic acid vapour between 1 and 15.5μ has been investigated under a variety of temperature conditions. The spectrum at room-temperature gives essentially the absorption of the double molecules alone, while that at 140°C . gives the absorption of the single molecules. The results are interpreted in terms of the hydrogen bonding existing in the double molecule. In addition an attempt to prepare and investigate pure formic acid-*d* is reported. [For Part III see Abstract 4543 (1937).] AUTHORS.

4129. Vibration Spectra and Molecular Structure. Part V. Infra-Red Studies on Light and Heavy Acetic Acids. R. C. Herman and R. Hofstadter. *J. Chem. Phys.* 6. pp. 534-540, Sept., 1938.—The infra-red absorption spectra of CH_3COOH and CH_3COOD between 1 and 15.5μ have been obtained with a rock-salt prism spectrometer. The association of CH_3COOD has been studied and a value of the heat of dissociation obtained. Positions of the hydrogen and deuterium bonded $\text{O}-\text{H}-\text{O}$ and $\text{O}-\text{D}-\text{O}$ frequencies are given. Making certain assumptions, a value for the shorter $\text{O}-\text{H}$ and $\text{O}-\text{D}$ distances in the dimer rings is found to be $1.07 \text{ \AA}$. [For Part IV see preceding Abstract.] AUTHORS.

4130. Vibration Spectra and Molecular Structure. Part VI. Infra-Red Absorption Spectrum of Heavy Formic Acid. R. Hofstadter. *J. Chem. Phys.* 6. pp. 540-543, Sept., 1938.—The infra-red absorption spectra between 1 and 15.5μ of the monomer and dimer of HCOOD have been found with a rock-salt prism spectrometer. The position of the vibration characteristic of the "deuterium bond" in HCOOD has been determined and permits an approximate calculation of the shorter OD distance in the dimer ring. As in CH_3COOD the distance is found to be $1.07 \text{ \AA}$. AUTHOR.

4131. Reflection Spectra of Solid Organic Substances. T. Guilmart. *Comptes Rendus*, 207. pp. 289-291, July 25, 1938.—A brief description is given of the experimental arrangements used in measuring the visible and u.v. reflection spectra of solids. A photographic method was used and intensities of the spectral bands were measured as well as their positions. Results are given of measurements in the u.v. on a series of amides $\text{C}_6\text{H}_5(\text{CH}_2)_n\text{CONH}_2$ where $n = 0, 1, 2, 3, 4, 5, 6$, with reference to the variation with n of the spectral characteristics due to the C_6H_5 and CONH_2 groups. D. H. F.

4132. Absorption Spectra of Coordination Compounds. Part III. R. Tsuchida and M. Kobayashi. *Chem. Soc. Japan, Bull.* 13. pp. 471-480, July, 1938. *In English*.—The absorption spectra of several chromic complexes are examined and discussed in detail. All the compounds examined are found to have at least two bands and in some cases there are three or even four. It is found that the spectrochemical series is coincident with that for cobaltic complexes. The stability of the chromic complexes is discussed and some of the methods of preparation are explained. [For Part II see Abstract 3720 (1938).] A. H.

4133. Absorption Spectra of Phthalocyanines and Associated Compounds. J. S. Anderson, E. F. Bradbrook, A. H. Cook and R. P. Linstead. *Chem. Soc., J.* pp. 1151-1158, Aug., 1938.—The absorption spectra in the visible region of phthalocyanine, fifteen of its metallic derivatives, and a number of associated compounds containing the tetraporphin (porphyrine) ring have been measured. The spectrum of phthalocyanine is composed of a system of at least seven bands, the main absorption occurring between 6000 and 7000 Å. The relationships between the various spectra are discussed, and they are correlated with the spectra of porphyrins and azaporphyrins. AUTHORS.

4134. Absorption Spectrum of Biacetyl between 1500 and 2000 Å. V. R. Ellis. *Am. Chem. Soc., J.* 60. pp. 1864-1866, Aug., 1938.—The absorption spectrum of biacetyl vapour has been investigated with a vacuum grating spectrograph between 2000 and 1550 Å. Absorption regions are found which correspond in general to those in acetone and ethyl methyl ketone, although they are displaced to longer wave-lengths as would be expected due to the juxtaposition of two carbonyl groups. A prominent frequency difference of about 1220 cm^{-1} is found in the upper state, although the presence of another difference almost exactly half as great renders the interpretation ambiguous. Certain bands occur at wave-lengths sufficiently displaced from those in acetone and ethyl methyl ketone to permit them to be used for the identification of biacetyl in the presence of these other substances. AUTHOR.

4135. Spectra of HgH and HgD. Y. Fujioaka and Y. Tanaka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 797.* pp. 713-740, July, 1938. *In English.*— $^2\Pi_1 \rightarrow ^2\Sigma$ and $^2\Pi_3 \rightarrow ^2\Sigma$ bands of HgH and HgD are photographed in the 2nd-order of a 6 m. concave grating. From the analysis the constants of the lower $^2\Sigma$ states are calculated. The spin doubling of the $^2\Sigma$ state is found to be remarkably large. The values calculated for B_v show that their variation with v is so large that it is hardly reliable to use the usual expansion formula. However, the calculation of B_v gives $B_{v,H} = 5.5490 \pm 0.0027$, $B_{v,D} = 2.7989 \pm 0.0029$ and $B_{v,D}/B_{v,H} = 0.5044 \pm 0.0006$. Although this value is not in good agreement with $\rho^2 = 0.5029$, because of the above mentioned circumstance no theoretical discussion is possible. The calculation of the vibrational constant ΔG_{v+1} gives a very rapid decrement for increasing v in the case of HgH as compared with that of HgD. Actually, the use of the expansion formula for G_v gives the wrong sign for y, w , in the case of HgH. A. H.

4136. Band Spectrum of MgD⁺. H. Juraszńska and M. Szulc. *Acta Physica Polonica, 7.* 1. pp. 49-58, 1938. *In German.*—The band system $^1\Sigma^+ \rightarrow ^1\Sigma$ has been investigated and consists of numerous bands between 3600 and 2600 Å. The rotation and oscillation constants have been determined and compared with the constants of ionised MgH. F. S.

4137. Band Spectra of Nitrogen Forming a Rydberg Series. T. Takamine, T. Suga and Y. Tanaka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 807.* pp. 854-864, Aug., 1938. *In English.*—Using a 1 m. vacuum spectrograph of Siegbahn type, the absorption bands of N_2 forming a Rydberg series were studied. The absorption bands appear strongly when a condensed discharge is passed through a long He tube, with the vacuum spectrograph containing a small amount of N_2 . Compared with the earlier work of Hopfield, these absorption bands are now extended to the 9th member. Of special interest is the appearance

of an emission band also forming a Rydberg series and converging to the same limit ($A' \Sigma^+$ of molecular N_2) as that of the absorption bands. These emission bands are apparently due to the trace of N_2 in the discharge tube which is present as an impurity. **AUTHORS.**

4138. U.V. Band Spectra of HgCl, CdCl and ZnCl. S. D. Cornell. *Phys. Rev.* 54. pp. 341-346, Sept. 1, 1938.—The spectra of the chlorides of Hg, Cd, and Zn, excited in a h.f. discharge, are examined at high dispersion in the region 3200-2000 Å. Vibrational analyses of several systems are presented. Included is a discussion of the electronic configurations involved in the systems analysed. **AUTHOR.**

4139. Band Spectrum of PbF. Part II. G. D. Rochester. *Roy. Soc., Proc.* 167A. pp. 567-580, Sept. 23, 1938.—An account is given of the emission and absorption band spectra of PbF. Six new systems and two continua are found. The vibrational constants of the stable electronic states of PbF are as follows in cm^{-1} :

State	Probable type	ν_0	ω_0	$x\omega_0$	Observed in, emission (E), absorption (A)
X_1	$^3\Pi$	0	507.2	2.30	E and A
X_2		8266	531.1	1.50	E
A	$^1\Delta$	22,567	397.8	1.77	E and A
B	$^3\Sigma$	35,643	612.8	3.42	E and A
C	$^1\Delta$	38,046	594.0	2.50	A
D	$^3\Pi$	43,820	600.0	—	A
E	—	45,400	565.0	—	A
F	$^3\Pi$	47,870	630.0	—	A
2440 Å continuum maximum		~ 41,000		A	
3050 Å continuum maximum		~ 32,800		E	

The width of the ground state, i.e., 8266 cm^{-1} , is the largest yet recorded. Numerous examples of predissociation are found. [For Part I see Abstract 712 (1936).] **AUTHOR.**

4140. Optical Behaviour of Dissolved Ions and Structure of Electrolytic Solutions. Part VII. G. Kortüm. *Zeits. f. phys. Chem.* 40. Abt.B. 6. pp. 431-438, 1938.—Measurements are described with respect to the extinction of the fluorescence of eosin anions in extremely dilute aqueous solution by inorganic and organic compounds. This work is an extension and a confirmation of the earlier results [see Abstract 5350 (1937)]. The significance of solvation is established from several examples whereas the ionic behaviour is in numerous cases in accord with the Debye-Hückel limiting laws, and therefore to be ascribed to purely electrostatic interaction of the ions; nevertheless within certain dilution ranges there are specific optical properties of the ions which indicate complete independence from these inter-electrostatic forces and dependence only on the forces between the ions and solvent molecules (solvation forces). The region within which the van der Waals' forces operate is also discussed. **H. H. Ho.**

4141. Deformation of Molecules and Their Vibration Spectra in Condensed Phases. E. Bauer and M. Magat. *Physica*, 5. pp. 718-724, Aug., 1938. *In French.*—It is well-known that the infra-red and Raman spectra of molecules containing the radicals OH and NH show a widening of the bands and a displacement towards lower frequencies in condensed phases as compared with the gaseous state. This can be accounted for in a satisfactory manner by considering the forces acting between molecules; and it is not necessary to introduce *ad hoc* assumptions; such as that of a specific "H-bond." **R. P.**

4142. Fluorescence and Absorption Spectra of Pr^{+++} and Eu^{+++} . Part II. H. Lange. *Ann. d. Physik*, 32, 4, pp. 361-377, June, 1938.—

In order to investigate the splitting of the ground terms of Eu^{+++} by crystal fields the fluorescence spectra at -180°C . given by Eu^{+++} incorporated in various salts have been studied as well as the absorption spectra in the visible region from 20°C . to -180°C . The results are shown in tables and in reproduction of the spectra. A comparison of the spectra obtained with Eu salts alone and also when incorporated in alkaline-earth sulphates indicates a much more complicated effect of crystal field on the atomic lines in the second case. The results will be discussed in detail in a further contribution. [For Part I see Abstract 2470 (1938).] J. E.

4143. Diffuse Fluorescence Spectra of the Ions of the Rare Earths in Solution and in Crystals. P. C. Mukherji. *Zeits. f. Physik*, 109, 9-10, pp. 573-585, 1938.—The fluorescence spectra of the trivalent ions of La, Ce, Pr and Nd in solution, in crystals and partly also in dehydrated crystals have been obtained. In solution, one wide diffuse band is common to all these ions. In addition, Pr and Nd emit also two weaker bands of shorter wave-length, and Nd a further one of greater wave-length. For monochromatic excitation the short-wave bands are only emitted if the frequency of the exciting radiation exceeds the mean frequency of the shorter band. In crystal form, La ions do not fluoresce, whereas the number of bands from Ce depends on the anion and on the frequency of the exciting radiation. La and Ce produce a measurable continuous u.v. absorption. The results are discussed and an interpretation is suggested. R. P.

4144. Raman Spectra of Crystalline Hydrates. E. Canals and P. Peyrot. *Comptes Rendus*, 207, pp. 224-226, July 18, 1938.—The Raman spectra of a number of hydrates have been obtained. They are all different and unlike that of water. Certain substances—gypsum, hyposulphite of sodium, strontium chloride and alum—have a faint band near 3600 cm^{-1} which may correspond to the 3654 cm^{-1} of water vapour, attributed by Cabannes to monohydrol. J. E.

4145. Raman Spectra of Ammonia and the Ammonium Ion. G. Costeau. *Comptes Rendus*, 207, pp. 285-286, July 25, 1938.—Liquid NH_3 at -40° exhibits five Raman displacements greater than 3000 cm^{-1} , viz., 3210, 3300, 3380, 3460, 3545 cm^{-1} ; the first three are strong and well-established; the last two are weak and have not previously been recorded. These five lines, with slight modification, are also found in the spectra of a strong aqueous solution of NH_3 and in solutions of NH_4NO_3 and NH_4CNS in liquid NH_3 , respectively $\text{NH}_4\text{NO}_3 \cdot 2\text{NH}_3$ (I) and $2\text{NH}_4\text{CNS} \cdot 5\text{NH}_3$ (II). The spectra of (I) and (II) are compared with that of an aqueous solution of NH_4NO_3 and displacements ranging from 1370 to 1690 cm^{-1} and their origin, are discussed. W. R. A.

4146. Use of Raman Effect in Analysing Isomeric Dihalogenated Benzenes. R. Pajeau. *Comptes Rendus*, 207, pp. 344-345, Aug. 1, 1938.—The bromination of benzene and of chlorobenzene to produce paradihalogenobenzenes, catalysed by beryllium bromide and by aluminium chloride has been followed by Raman spectral observations. Aluminium chloride favours the production of the three isomers, whilst with beryllium bromide no *meta* derivative was detectable. W. R. A.

4147. Raman Spectrum and Fluorescence of Dioxane. H. W. Hunter. *J. Chem. Phys.* 6, pp. 544-545, Sept., 1938.—The Raman spectrum of dioxane is shown to include eleven lines, some of which have VOL. XLI.—A.—1938.

been reported by previous investigators. Dioxane, when irradiated by the u.v. light from a mercury arc, gives scattered light whose spectrum shows a broad continuous band in the visible region. Intensity of the scattered band diminishes rapidly with increasing temperature of the dioxane. Shortened time exposures bring out two maxima at about 5800 and 4500 Å. A similar phenomenon has been observed in cyclohexane.

AUTHOR.

4148. Raman Spectra and Structure of Associated Molecules of Organic Acids. V. Cellinzev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 489-491, 1938. In English.—The various proposed structures for organic acids associated in the form of dimers are discussed, together with the evidence supporting them. The author rejects the "acetal" form and also the structure in which there is a H bond. He puts forward a structure, which involves a quadrivalent O atom. It is claimed that this structure explains why in certain cases oscillations corresponding to hydroxyl bonds and simple carbonyl groups are absent, or at least much reduced, in the Raman spectra of acids. J. I.

4149. Raman Spectra of Organic Silicates. B. V. Thosar and R. N. Bapat. *Zeits. f. Physik*, 109. 7-8. pp. 472-476, 1938.—The Raman spectra of methyl, ethyl, butyl and isoamyl silicate were studied. The four fundamental vibrations of the SiO_4 group at 650, 840, 1082 to 1100, and 1178 to 1300 cm^{-1} were identified and the values compared with those found by Weiler for the methyl ester and its polymers. W. S. S.

4150. Vibrations and Structure of Ions of the Type XO_3 . T. G. Kujumzells. *Zeits. f. Physik*, 109. 9-10. pp. 586-597, 1938.—Raman spectra of concentrated solutions of carbonates, nitrates, chlorates, bromates and iodates showed unknown lines which completed the analysis of the vibration frequencies. It is concluded that the ions CO_3 and NO_3 are plane, whereas ClO_3 , BrO_3 , and IO_3 form pyramids. R. P.

***4151. Interval Recorder for Analysis of Spectra.** G. R. Harrison. *J.O.S.A.* 28. pp. 290-292, Aug., 1938.—A device is described which automatically combs a list of wave numbers punched on a paper tape for pairs of lines having constant differences, and records the wave numbers of these pairs on kiné film. It supplements the spectrum interval sorter, which makes use of the same punched tape and automatically places all similar intervals in juxtaposition so that frequently recurring intervals can be detected. The interval recorder is set successively for the various intervals which the interval sorter chart shows to be important. When a light beam passes simultaneously through holes in both upper and lower sections of a looped portion of the tape, a photo-cell flashes an argon lamp which illuminates two wave number dials turning in synchronism with the motion of the tape, and records their readings. By means of a calibrated differential the two dials and the tape can be set for any desired wave-number difference. A. H.

***4152. Variable-Angle Liquid-Prism Spectrometer.** T. V. Starkey. *Journ. Sci. Instruments*, 15. pp. 290-292, Sept., 1938.—This paper describes a spectrometer of the auto-collimating type in which a liquid prism is used, and which is therefore especially suitable for the accurate determination of the refractive indices and dispersive powers of liquids. It is with its application to the measurement of refractive indices that this paper is chiefly concerned. AUTHOR.

See also Abstracts 3891, 3894, 3917, 4013, 4014, 4015, 4075, 4077, 4090, 4195.
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TRANSMISSION.

4153. Measurement of Velocity of Light over a Single Journey. R. J. Clark. *Phil. Mag.* 26. pp. 361-376, Sept., 1938.—It is shown that if two clocks, previously synchronised by using the known velocity of any signals over the double journey between them, are used to measure the velocity of those signals over a single journey, the result will necessarily be that the velocity over a single journey is equal to that over a double one. It is also shown that when wave trains are employed for signals, and also that the standard length employed, depends on waves of the same kind as the signals, the result may be that the measured velocity of the waves is the same in every direction. If the dimensions of material bodies depend on a mechanism involving electromagnetic waves, and if the frequency of a moving clock alters according to the classical theory of Larmor and Lorentz, then measurements made in a physical system may be as required by the restricted theory of relativity. The possibility of measuring the velocity of light over a single journey is discussed, and an outline is given of a possible method.

AUTHOR.

VISION.

4154. Vision in Nature and Vision Aided by Science. (Lord) Rayleigh. *Nature*, 142. pp. 327-338, Aug. 20, 1938. *Science*, 88. pp. 175-181, Aug. 26, and pp. 204-208, Sept. 2, 1938. *Presidential Address to the British Assoc., Cambridge, Aug., 1938.*—The contrast and apparent discrepancy between sensual impressions and the results of modern science are briefly mentioned but it is pointed out that the senses were not primarily developed for research purposes and that it is necessary to adapt them for that purpose. An account of some of the ways in which such adaptations are made occupies the main portion of the address. The mechanism of the human eye is briefly described and is followed by a description of various artificial ways of extending its observational power. Amongst them are mentioned the use of simple lenses in spectacles and telescopes and of compound lenses in microscopes, the u.v. microscope, the electron microscope and the use of X-rays for examining atomic structure; there follows a section on colour vision with reference to the photographic plate and to photoelectricity and finally a short account is given of the principles of television. An answer is given to the indictment that science is the source of war. The feasibility of desisting from work which might have a possible application to war is discussed and examples are given in illustration. It is emphasised that the urge to explore the unknown, whether for good or ill, is deep-rooted in our nature and, although the world is prepared to accept and to use any knowledge gained, it is not ready to accept the advice of scientific men as to how such knowledge should be applied in human relations.

H. J. H. S.

See also Abstract 4102.

X-RAYS.

***4155. X-Ray Tube for Crystal Analysis and Stress Measurements.** J. E. de Graaf and W. J. Oosterkamp. *Journ. Sci. Instruments*, 15. pp. 293-303, Sept., 1938.—The factors are discussed which determine the development of an X-ray tube for crystal analysis, viz., the brightness of the focal spot, its shape and load distribution, the construction of the tube and its manipulation, and the purity of the spectrum.

AUTHORS.

*4156. Technique of X-Ray Spectral Analysis. P. Brauer. *Zeits. f. techn. Physik*, 19, 8, pp. 232-237, 1938.—The advantages of using an electrostatically screened antikathode for X-ray spectral analysis are outlined and the analysis of powdered specimens is illustrated, very short exposure times being achieved. J. T.

*4157. X-Ray Diffraction of Substances under High Pressures. R. B. Jacobs. *Phys. Rev.* 54, pp. 325-331, Sept. 1, 1938.—An apparatus is described which may be used for X-ray diffraction work on substances under pressures up to 5000 atm. The compressive medium is He. A small (2.5 cm. radius) Debye-Scherrer type camera is used. The camera, complete with film and specimen, was placed inside the high pressure chamber. The X-rays make their entrance through a Be window in the chamber wall. A general blackening of the film by scattering from He is prevented by slits installed for this purpose, and the quality of the X-ray diffraction lines is quite good. Results are given for the transition AgI (II) to AgI (III). The crystal structure of AgI (II) is found to be cubic (NaCl type). The volume change in this transition is found to be greater when measured by X-ray methods than when measured by over-all methods. An interpretation of this is given. Some results on Cd and RbCl are also described. AUTHOR.

4158. Mass Absorption Coefficients of Monochromatic X-Rays in Water and Aqueous Solutions. I. Müller. *Ann. d. Physik*, 32, 7, pp. 625-639, Aug., 1938.—Using a source of monochromatic X-rays, the $K\alpha^1$ doublet from 28 elements from Mn (2.0988 Å) to Bi (0.1623 Å) produced by the filter difference method of Küstner, measurements of the mass absorption coefficients have been made for water and aqueous solutions of compounds of Se, Br, Cd, I, Ba, Ce and Tl, on either side of the K-absorption edge. By a compensation method, the absorption of the water and of the water of crystallisation contained in a cell of desired thickness introduced in the beam of X-rays, was taken as I_0 , so that only the absorption of the pure substance was observed. A measuring apparatus is described by which the thickness of the cell wall and of the solution could be determined with great accuracy. For water, an absorption formula $\mu/\rho = 2.5404\lambda^{3.216} + 0.21944f(\lambda)$ was determined which is in good agreement with that found by Küstner and Trübstein [see Abstract 2145 (1937)]. The results are given in tables and graphs and the linear sections on either side of absorption edge, when $\log \mu/\rho$ is plotted against $\log \lambda$, shows that the $C\lambda^n$ law is fulfilled. The transition at the K-absorption edge is shown to be $\mu_2/\mu_1 = 63.868 Z^{-0.6207}$ agreeing within $\pm 4.1\%$ of the data given by Rindfleisch [see Abstract 2150 (1937)].

T. A. C.
4159. M-Series of Elements from Cd(48) to Ce(58). H. Klesig. *Zeits. f. Physik*, 109, 9-10, pp. 671-684, 1938.—The M-series has been studied for elements from Cd to Ce, with the exception of I, X, and Cs, using a plane grating spectrometer. The Moseley diagrams are given and two new Moseley lines are discovered which are ascribed to the transitions of $M_{IV}O_{II}$ and $M_{IV}O_{III}$. For La(57) the $Ma\beta$ doublet is observed although according to the Siegbahn level scheme the $N_{VI,VII}$ level is not occupied. The energy level values are calculated and the breadths of the $M\epsilon$ lines measured. There appears to be a definite relation between the breadths and the periodic system of the elements. C. J. B. C.

*4160. Measurement of X-Ray Intensities with a Counter. P. Ohlin. *Phys. Zeits.* 39, pp. 567-571, Aug. 1, 1938.—A description is

given of the construction and use of a high vacuum crystal spectrograph attached to a counting tube for the measurement of small X-ray intensities. A new amplifier method of counting impulses is used and its mode of action explained. In order to illustrate the working of the apparatus the intensity distribution of the Ca K_{α} doublet has been measured and the results shown side by side with the photometric curves of the same lines. J. E. R.

4161. Absolute Wave-Length of $K_{\alpha_{1,2}}$ Line of Al. F. Tyrén. *Zeits. f. Physik*, 109, 11-12, pp. 722-727, 1938.—The author has determined the absolute wave-length of the $AlK_{\alpha_{1,2}}$ doublet with a concave grating at grazing incidence (angle of incidence 89°). The grating had a focal length of 942 cm., and there were 576 lines per mm. The value of the wave-length obtained is $8.3397 \pm 0.0003 \text{ \AA}$. This result furnishes the value $e = (4.803 \pm 0.004)10^{-10}$ e.s.u. for the unit electronic charge. L. K.

See also Abstracts 3906, 3907, 4254, 4263.

HEAT.

CALORIMETRY.

4162. Heat Capacity of Ethylene. D. B. Pall, J. W. Broughton, and O. Maass. *Canad. J. of Research*, 16, Sect. B, pp. 230-241, July, 1938.—The heat capacity of ethylene at constant volume has been investigated through the critical range, between 6.5° and 27°C ., at an average density slightly greater than the critical. The heat capacity in the immediate neighbourhood of the critical temperature is found to be a function of the previous thermal treatment of the system. The results indicate the persistence of a large amount of molecular interaction in ethylene above the critical temperature, and are in agreement with the concept that the liquid state of aggregation can persist above the temperature at which the visible meniscus disappears. AUTHORS.

4163. Specific Heats of Beryllium, Phosphorus and Titanium Nitrides. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 810, pp. 888-896, Aug., 1938. In English.—The mean specific heat of Be_3N_2 was measured by the ice calorimeter over three temperature intervals $0^\circ \sim 99.5^\circ \text{C}$., $0^\circ \text{C.} \sim 303.3^\circ \text{C}$., $0^\circ \text{C.} \sim 500.3^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature intervals is obtained: $C = 0.2726 + 7.884 \times 10^{-4} - 5.163 \times 10^{-7}T^2$. The mean specific heat of P_3N_5 was determined by the same method over two temperature intervals $0^\circ \text{C.} \sim 99.6^\circ \text{C}$., and $0^\circ \text{C.} \sim 305.3^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature ranges is obtained: $C = 0.2027 + 6.252 \times 10^{-4}T$. The mean specific heat of TiN was also determined by the same method over three temperature intervals $0^\circ \text{C.} \sim 99.6^\circ \text{C}$., $0^\circ \text{C.} \sim 305.3^\circ \text{C}$., and $0^\circ \text{C.} \sim 500.5^\circ \text{C}$., and the equation of the true specific heat within the limit stated by the above temperature intervals is obtained: $C = 0.1410 + 1.918 \times 10^{-4}T - 1.127 \times 10^{-7}T^2$. [See also Abstract 3311 (1938).] AUTHOR.

4164. Specific Heat of Nickel. C. Sykes and H. Wilkinson. *Phys. Soc., Proc.* 50, pp. 834-851, Sept. 1, 1938.—The {specific-heat, temperature} curves for four different types of Ni have been determined, VOL. XLI.—A.—1938.

and the effects of method of manufacture, heat treatment, and chemical composition have been ascertained. The results, together with those obtained by previous investigators, are reviewed, and an attempt is made to evaluate the most probable (C_p , T) curve for nickel for the temperature range 100°C . to 600°C . AUTHORS.

CONDUCTION.

4165. Thermal Conductivities of Liquid O_2 and N_2 . G. Hammann. *Ann. d. Physik*, 32. 7. pp. 593-607, Aug., 1938.—A method for the determination of thermal conductivity of liquids at low temperatures is described. The arrangement consists of a horizontal thick layer of the liquid, with a heating coil above and a cold plate below, both in contact with the liquid. Loss of heat from the sides of the layer and the top of the heating coil is prevented by means of an evacuated chamber. Thermocouples immersed in the layer of liquid record the vertical temperature fall. The apparatus is inside a Dewar flask containing liquid N_2 . Observations are made during the steady state. The thermal conductivities of liquid O_2 and N_2 , and of mixtures of the two liquids were determined at various temperatures within the temperature range -191.1 to -208.5°C . The values obtained at -200°C . for liquid O_2 and N_2 were 0.000498 and 0.000496 gm. cal./sec. cm. $^\circ\text{C}$. respectively. For the mixtures, the values were lower, the least value, 0.000460 gm. cal./sec. cm. $^\circ\text{C}$. at -200°C . being for a mixture of 45% liquid O_2 and 55% liquid N_2 . These results are considered accurate to $\pm 1\%$. S. W.

CONVECTION.

See Abstract 3935.

TEMPERATURE.

4166. Attainment of Low Temperatures. C. G. Darwin. *Manchester Phil. Soc., Mem.* 82. pp. 49-66, April, 1937-1938.—An address on the history and present position of low temperature studies.

G. C. E.

***4167. Gas Thermometer for Very Low Temperatures.** A. H. Woodcock. *Canad. J. of Research*, 16. Sect. A. pp. 133-137, July, 1938.—A new form of He gas thermometer is described, which is designed for permanent installation in low-temperature equipment in order to cover the difficult region between the temperatures of liquid H_2 and of liquid He. The device departs radically from the usual gas thermometer practice by having the volume of gas which remains at room-temperature considerably larger than that of the thermometer bulb proper. It is shown theoretically that by this means the sensitivity, as compared with that of an ordinary gas thermometer with the same initial pressure and temperature, is greatly increased at the lowest temperatures. Thus it is possible to construct a thermometer which is sufficiently sensitive in the region below 20°K . to read temperatures to within 0.1° with the aid of an ordinary Hg manometer, and yet have a pressure only of the order of 1 atm. at room-temperature. An experimental test has shown that the device is entirely practicable. AUTHOR.

4168. Phenomena at the Temperature of Liquid Helium. E. F. Burton. *J. of Applied Physics*, 9. pp. 489-499, Aug., 1938.—The Kamerlingh Onnes, Simon and Kapitza methods of producing liquid He are sketched very briefly, together with the methods of reaching temperatures below 4°K . Low-temperature thermometry is touched upon

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and the two states of He and the properties at the transition point are summarised. The rest of the paper deals with the supraconductive state and various electric and magnetic theorems and properties which are connected with this state. E. H. D.

See also Abstracts 4071, 4110, 4177.

THERMOCHEMISTRY.

4169. Isotopic Effects in Heats of Dilution of Electrolyte Solutions and of Water-Dioxane-Mixtures. W. Birnthal and E. Lange. *Zeits. f. Elektrochem.* 44, pp. 679-693, Sept., 1938.—In continuation of previous work [see Abstract 4112 (1937)] on the properties of highly concentrated KF solutions, the isotopic effects on the heats of dilution of LiCl and LiBr and of certain other isotopic phenomena in the system dioxane water at 25° C. are now investigated. The paper is very comprehensive and is almost a survey of the general solution problem. Phenomena at many concentrations are described and discussed from the thermodynamic standpoint with numerous illustrative diagrams and a very complete Bibliography of 69 references. The paper should be consulted in its entirety as a valuable contribution to the present state of solution theory. H. H. Ho.

4170. Indetermination of the Intervals and Origin of Explosion Waves. G. Wataghin. *Comptes Rendus*, 207, pp. 358-360, Aug. 8, 1938.—Recently the author has indicated that there exists a new kind of indetermination in the spacing of explosion intervals corresponding to the limitations attendant on the measurement of impulses, limitations having the nature of the forces of β -radiation. This indetermination is now formulated by means of a new algebra of quantum states, in which there is added to the complete system of operator functions for the impulse p (for plane waves) a finite number of quantum states represented by other functions which, in general, are not orthogonal, but which for values of p lower than a certain critical value, differ by only a small amount from the ordinary expressions of the quantum theory. This new method is utilised for the mathematics of explosions. H. H. Ho.

See also Abstracts 3921, 4192.

THERMODYNAMICS.

4171. Molecular Force and Imperfect Gases. Weng Wen-Po. *Phil. Mag.* 26, pp. 225-244, Aug., 1938.—On the assumption that the force between two spherical molecules is composed of an attraction and a repulsion, each varying as an inverse power of the distance between the molecules, the force can be represented by an equation containing four constants. It is then possible to arrive at values for the two indices from experimental data for the Boyle temperature, T_b , at which the second virial coefficient vanishes, and the inversion temperature of the Joule-Thomson effect. Information regarding the law of molecular force is also obtained from a study of the corresponding states and reduced variables, since such ratios as T_b/T_c , p_c/p_c and LM/RT_c should each have constant values for molecules whose forces of attraction and repulsion obey similar power laws. p_c = density of liquid, p_c = critical density, VOL. XLI.—A.—1938.

L = latent heat of evaporation per gm., M = molecular weight, R = gas constant and T_c = critical temperature. R. W. P.

4172. Corresponding-States Equation for General Physico-chemical Computations. F. G. Keyes. *Am. Chem. Soc., J.* 60. pp. 1761-1764, Aug., 1938.—It is shown that the recent fugacity-pressure ratio charts for constant reduced temperatures *versus* reduced pressure, taken literally, lead at low pressures to a simple reduced equation of state. The constants of this equation are deduced from the values of the van der Waals constants deduced for 13 substances by Beattie and Bridgeman. It appears that there is a distinguishable difference in the reduced-constants values for non-polar compared with polar gases. A test of the usefulness of the reduced equation is made by computing the equilibrium constants for the Haber equilibrium for high pressures and for Gillespie's experiment. In applying the equation to mixtures of gases use was made of a "constants" combination rule previously found valid for N_2 - CH_4 mixtures. The results indicate that the reduced equation is useful for making approximate physico-chemical calculations involving gases under pressure. The present reduced equations suffer from the assumption that a van der Waals type of molecular field is assumed valid, and more precise data for gases and gas mixtures at low pressures are needed before the implications deducible from the existing fugacity-pressure ratio charts can be explored satisfactorily. AUTHORS.

4173. Transformation $II \rightleftharpoons III$ of Solid H_2S and D_2S . K. Clusius and K. Weigand. *Zeits. f. Elektrochem.* 44. pp. 674-679; *Disc.*, 679, Sept., 1938.—Solid H_2S and D_2S exist in 3 modifications of which I and II are optically isotropic, while III is anisotropic. An experimental procedure is described by which the pressure displacement of the transformation $II \rightleftharpoons III$ can be followed up to 250 kg./cm². From the slope of the transformation curves, and the heats and temperatures of transformation, the volume difference of the two phases can be evaluated. The transformation $III \rightarrow II$ only produces an increase of 2.5 ± 1 per 1000 in the lattice distance, and therefore cannot follow from a dynamic equilibrium which exists between separate molecules; rather must it be assumed that only larger lattice regions can come together statistically under energetically favourable conditions. A similar mechanism may be effected in many transformations between solid phases. The discussion deals mainly with sizes of crystals. H. H. Ho.

4174. Nernst Heat Theorem and Irreversible Processes at Low Temperatures. A. R. Ubbelohde. *Phil. Mag.* 26. pp. 260-268, Aug., 1938.—The author examines the extension of the heat theorem in some detail and deals with the following divisions of the subject: (1) Application of thermodynamics to spontaneous charge, (2) the use of thermodynamic variables in describing irreversible processes, (3) experimental examples of the application of the heat theorem to irreversible processes at low temperatures—electrical resistance, thermal conductivity and viscosity. Although further experimental evidence is required before the scope of the proposed extension of the Nernst heat theorem can be properly estimated, the conclusions arrived at in this paper are of sufficient interest to support the attempt to classify irreversible processes at low temperatures from this point of view. The paper should be consulted in its entirety. H. H. Ho.

4175. Entropies of Aqueous Ions. W. M. Latimer, K. S. Pitzer and W. V. Smith. *Am. Chem. Soc., J.* 60. pp. 1829-1831, Aug., 1938.—VOL. XLI.—A.—1938.

The calculation of the entropies of aqueous ions have been completely revised and extended to include eleven additional ions. AUTHORS.

See also Abstracts 3921, 3966, 4090, 4126, 4127, 4177.

VAPORISATION AND CONDENSATION.

4176. Vaporisation Coefficient of Water. H. Mache. *Zeits. f. Physik*, 110. 3-4. pp. 189-196, 1938.—The vaporisation coefficient is defined to be the rate, in cm./sec., at which the surface of water falls by evaporation, provided the vapour pressure of the immediate gas or vapour layer is kept constant at about 1 mm. of Hg below the saturation pressure corresponding to the temperature of the water at its surface. Previously [see Abstract 5387 (1937)] the author has described two processes for the determination of the vaporisation coefficient of water, which, however, gave merely the order of the coefficient, as it was found that the value of the coefficient depended to a large extent on the condition of the water surface. In the present series of experiments, the water is superheated as before, but the evaporation takes place at freshly formed clean water surfaces, and into pure water vapour. Larger values of the vaporisation coefficient than those obtained previously are observed. S. W.

4177. Peculiarities in Liquefaction of Helium. I. L. Zelmanov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 469-470, 1938. *In English.*—The well-known T-S diagram published by Keesom and Hanthoff, designed to solve unambiguously the problem of the liquefaction coefficient for any case whatever, does not afford an explanation of the maximum observed by K. Onnes at 20 atm. pressure for He, and this discrepancy was held by Kapitza to be due to inexactitude of the diagram. It is now shown by a consideration of the T-S diagram that the above discrepancy may be merely an apparent one and result from an inaccurate calculation of the liquefaction coefficient, since the latter is not determined unambiguously by the drop of the enthalpy on the hot end of the heat-exchanges but depends also upon the course of the isenthalpies in the region of the diagram adjacent to the boundary curve of the liquid. The introduction into the scheme of the liquifier of an additional throttle-valve is shown to solve the problem. H. H. Ho.

4178. Activity Coefficient of CoCl_2 in Aqueous Solution. R. A. Robinson. *Faraday Soc., Trans.* 34. pp. 1142-1143, Sept., 1938.—The activity coefficient of CoCl_2 in aqueous solution between 0.05 and 2 M has been determined at 25° by the isopiestic vapour pressure method. The results may be interpreted tentatively as indicating complete dissociation of the salt as in the case of the chlorides of the alkaline earth metals and in contrast to the chlorides of Zn, Cd and Hg. AUTHOR.

See also Abstract 3966.

ACOUSTICS.

4179. Effect of Ultrasonic Vibrations on the Discharge Potential of Hydrogen. R. Piontelli. *Accad. Lincei, Atti*, 27. pp. 357-363, April 3, 1938.—A 250 W quartz generator, $n = 1.196 \times 10^6$, is used with vertical Hildebrand Pt electrode in cylindrical glass tube 2.6×2.45 cm., with calomel electrode for collection; voltage is measured by a sensitive potentiometer galvanometer, and current by a Weston milliammeter. Circulation of the electrolyte is found to have a marked effect on voltage, especially at low current density, so that strictly reproducible conditions must be used. After equilibrium is established p.d. is measured, the vibration is then applied and the measurement repeated, in general a marked depolarisation sets in up to 0.8 V. Current/p.d. curves reproduced for 0.1 N KCl and NaOH are approximately hyperbolic. The author suggests that at low current density it is probably deabsorption which decides the cathodic potential under ordinary conditions; after passing the region of complete saturation this transforms into the Gurney phenomenon characteristic of acid solutions, in which electrons cannot penetrate the electrode surface, and it is probably this which then determines the cathodic potential. Ultrasonic vibration will remove deposited products from the electrode surface; it is noteworthy that when gas is freely evolved the action of ultrasonics is not so marked. The discharge potential phenomenon is therefore comparable with double layer action or indeed to a special type of chemical action. [See also Abstract 4629 (1937).] D. R. H.

4180. Supersonic Measurement of Adiabatic Elasticity of Crystals. E. Baumgardt. *Comptes Rendus*, 207. pp. 273-274, July 25, 1938.—A method is proposed by which the three moduli of adiabatic elasticity of a crystal may be determined. The wave-length of the supersonic waves employed is to be measured for laminae cut along three different directions from a crystal belonging, say, to the cubic system, using the frequencies at which the laminae are most transparent [see Abstract 2958 (1938)]. The three moduli of the crystal can then be calculated.

G. E. A.

4181. Dispersion of Solids in Liquids by Supersonic Waves. K. Söllner. *Faraday Soc., Trans.* 34. pp. 1170-1174, Sept., 1938.—Solid bodies of low cohesion, e.g., mica, steatite, gypsum, graphite, sulphur, haematite are dispersed in liquids by the action of supersonic waves. The dispersions so obtained contain many particles of semi-colloidal and colloidal size. The particles of suspensions and sols are also subject to further disintegration when irradiated with supersonics of high energy. This process is sometimes particularly effective and rapid. Solid metals, owing to their high cohesion and high ductility, have not, thus far, been dispersed by supersonics. AUTHOR.

4182. Supersonic Waves as Optical Shutter. O. Maercks. *Zeits. f. Physik*, 109. 9-10. pp. 598-605, 1938.—A method is developed in which the diffraction of light by standing sound waves in liquids is used for modulating the intensity of the light. It is possible to obtain satisfactory modulation at frequencies up to 10^7 $\sim$, provided sufficient care is taken to make the sound wave field uniform. R. P.

4183. Supersonic Interference Method of Measuring the Velocity of Sound. J. P. Cance. *J. de Physique et le Radium*, 9. pp. 308-312, July, 1938.—When two supersonic plane waves are propagated through VOL. XLII.—A.—1938.

a liquid and reach the surface, they give rise to interference effects in the surface common to the two beams which are analogous to the distribution of luminous intensity given by Fresnel's biprism. There are formed, along the equidistant lines of maximum tension, immobile ridges raised above the surface of the liquid, with corresponding troughs between. In carrying out measurements the two plane waves were furnished by quartz crystal plates of dimensions $50 \times 25 \times 1.5$ mm., having a natural frequency of about 2000 kc/s. Measurements of the distance apart of the ridges gave for toluene, water and Hg. results for the velocity of sound in close agreement with those of other workers.

4184. Sound Velocity in D_2O and its Compressibility. K. Yosioaka. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 806.* pp. 843-853, Aug., 1938. In English.—The velocity of sound both in H_2O and in D_2O of $d_{25}^{25} = 1.106$, was determined at temperatures between $25^\circ C.$ and $90^\circ C.$ at a frequency of 4900 kc./sec. by the method utilising the diffraction of light. The relation between the sound velocity and the temperature was found to be similar in both cases. The temperature at which the sound velocity becomes maximum is higher in D_2O than in H_2O . The relation between the adiabatic compressibility and the temperature was found also to be similar in both cases. The temperature at which the adiabatic compressibility becomes minimum is also higher in D_2O than in H_2O . At $25.0^\circ C.$, the sound velocity in pure D_2O was found by extrapolation to be 1.398 m. sec $^{-1}$, the adiabatic compressibility and the isothermal compressibility of pure D_2O 46.2×10^{-12} dyne $^{-1}$ and 46.4×10^{-12} dyne $^{-1}$ respectively. AUTHOR.

4185. Velocity of Supersonic Waves in Liquid Oxygen. H. W. Liepmann. *Helv. Phys. Acta*, 11. 5. pp. 381-396, 1938. In German.—Apparatus described in an earlier paper [see Abstract 5215 (1936)] is improved to enable absolute values of the velocity of supersonic waves in liquid O_2 to be obtained, the Debye-Sears effect being used. The boiling point of liquid O_2 is varied from -183.6° to -210° by rapid pumping. Between these two temperatures the velocity of waves of frequency about 10^6 increases approximately linearly with decreasing temperature from 911 to 1130 m/sec. The corresponding adiabatic and isothermal compressibilities are calculated. K. M. C.

4186. Transmission of Supersonic Waves Through Thin Sheets. R. Bär. *Helv. Phys. Acta*, 11. 5. pp. 397-407, 1938. In German.—The author extends the mathematical analysis [see Abstracts 1813 and 1814 (1938)] of the transmission of waves through thin sheets. It is recalled that when compression waves fall on a thin sheet immersed in a fluid, in general, both compression waves and flexural waves are excited in the sheet. Four simple special cases are now dealt with: (1) only compression waves are produced in the sheet; this is the case of perpendicular incidence; dealt with by Rayleigh, (2) only flexural waves are produced in the sheet; this occurs when the angle of refraction of flexural waves is 45° , (3) only one refracted compression wave is produced, which by internal reflection at the second surface is converted to a flexural wave, and (4) the converse case when only one refracted flexural wave is produced which is converted to a compression wave. In cases (3) and (4) the angles of incidence and sheet thickness are such that the transmission is unity. K. M. C.

4187. Transmission of Supersonic Waves Through a Rigid Sheet. F. Levi and N. S. N. Nath. *Helv. Phys. Acta*, 11. 5. pp. 408-431, 1938. *In German*.—Following a paper of Reissner [see Abstract 1814 (1938)] the transmission of waves through a rigid sheet immersed in a fluid is analysed and Reissner's general results are confirmed, although a different method is used. Total reflection is also dealt with. K. M. C.

4188. Masking Effect of Noise and the Mechanism of Hearing. H. Fletcher. *Nat. Acad. Sci., Proc.* 24. pp. 265-274, July, 1938.—The fluctuating voltage due to thermal motion of the electrons in a conductor is used to obtain a noise having a continuous spectrum. A broad frequency band of this noise, whose spectrum level is known at each frequency, is impressed upon the ear of an observer, while a pure tone of known frequency is raised to such an intensity that its presence can just be detected. It is found that the intensity of the pure tone is greater at high frequencies than low, indicating that the stimulation per nerve is not so great at low frequencies, so that the stimulus must be spread out over a greater number of nerve endings. It is assumed that the nerve endings which respond to a given frequency can be specified by their distance from the tip of the basilar membrane, and by a development of the above result this distance is evaluated for the whole of the auditory range. K. M. C.

See also Abstracts 3922, 3947, 3948, 3984, 4094 and

2967 and 2968B. Reduction of Structure-Borne Noise by Vibration-Attenuating Supports. A. J. King.

3008B. Vibration of Power Lines in Steady Wind. R. Ruedy.

3116B. Forced Vibration of Circular Membrane, Plate, or Hollow Sphere.

M. Matudaira and T. Hayasaka.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

4189. Kirchhoff Constraints and Sagittal Graphs. W. H. Ingram. *Phil. Mag.* 26. pp. 268-271, Aug., 1938.—From the dynamical view-point the graph (*i.e.*, the topological diagram) of an electric net is regarded as a representation either (1) of the constraints on, or (2) of the orthogonality of the coordinates according as they are, or are not, subject to conditions of constraint. In the first case the line segments of which the graph is composed have sense, in contradistinction to the second case. The two cases imply each other and are distinguished as sagittal and neutral respectively. The sagittal graph is not transformable to a geometrically different graph by any non-singular transformation of the dynamical variables (local currents), and does not exist for most variables thus related to the original, *e.g.*, variables related to the original by linear equations with irrational coefficients. On the other hand, the neutral graph may be transformed under certain circumstances to a geometrically different figure. Examples of graphs are discussed, and it is proved, from the more fundamental viewpoint now adopted, that currents not subject to Kirchhoff's law flow in circuits. H. H. Ho.

See also Abstract

2908B. Owen Inductance Bridge. T. Walcher.

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CONDUCTION AND DISCHARGE IN GASES.

4190. Generalisation of the Theory of Electrical Discharges. J. S. Townsend and E. W. B. Gill. *Phil. Mag.* 26. pp. 290-311, Aug., 1938.—The author's well-known general collision theory of the actions of electrons and positive ions in discharges is now extended to cover different kinds of discharges in gases at low pressures, and the conditions are investigated as to how the electric forces required to maintain the discharges are effected by a magnetic force. The most convenient method was found to be a comparison of the motion of electrons or the rate of ionisation under various conditions with the motion or rate of ionisation in a uniform electric field where there is no magnetic force. The theoretical results obtained have been tested experimentally by measuring the electric force required to start a discharge in dry air in a large spherical bulb.

H. H. Ho.
4191. Point to Plane Discharge in Air. A. F. Kip. *Phys. Rev.* 54. pp. 139-146, July 15, 1938.—A comprehensive series of experiments have been carried out on the current-voltage characteristics of a positive point to plane discharge in dry air. It is shown that all currents start abruptly and increase at firstly linearly and then more steeply with voltage until spark breakdown occurs. Fields at onset were calculated by the use of confocal paraboloids as electrodes. Introduction of a radioactive source into the gap shows that the sharp cut off of the corona current at lower voltages is due to lack of electrons. The initial current rise is found to increase as the gap separation is decreased. The curves are analysed in detail and explanations suggested for the various stages of the discharge process.

J. E. R.
4192. Explosive Potential in Benzene. E. Badereu. *Comptes Rendus*, 207. pp. 279-281, July 25, 1938.—This paper describes a theoretical development of the experimental results previously obtained [see Abstract 3798 (1938)]. He shows that $V_{\min.}/(pd)_{\min.} = (E/p)_0$ where E is the intensity of the electric field and p the gas pressure, the suffix 0 representing the values corresponding to the minimum in the Townsend curve, i.e., to $\eta_{\min.}$, the minimum energy expended by an electron in causing ionisation in the gas. The value of $\eta_{\min.}$ is comparatively large showing that more energy is required to cause ionisation in benzene than in simpler gases. The value is about 2000 as compared with 203 for H_2 , 940 for O_2 , and 822 for CO_2 . This high value is related to the many possibilities of energy absorption in benzene—rotation, vibration, dissociation, etc. It is also connected with the fact that a large number of ions are needed for the production of the discharge.

G. G.
4193. Townsend Ionisation Factor γ . R. Schöfer. *Zeits. f. Physik*, 110. 1-2. pp. 21-36, 1938.—Accurate striking potential measurements between electrodes of various materials in A have been made in order to calculate the Townsend ionisation factor γ in the striking formula $\gamma(e^{aV} - 1) = 1$. By varying the electrode spacing and the gas pressure, the dependence of γ on field strength and pressure has been determined. For Ni and Fe the factor is small and almost constant; for Ba and Mg it starts at a higher value, increases rapidly with increasing E/p_0 and then increases much more slowly. Further measurements in A, H_2 and air, using cylindrical electrodes with radii in the ratio 1:2 indicate very small variations with current direction, but larger variations with field strength. The theory put forward by Schade concerning the changes in discharge

current when the ion concentration in the gas is increased has been investigated. From measurements of the striking current and the lowering of striking voltage during irradiation of the discharge tube values of γ have been determined and found to be in good agreement with those calculated from the striking potentials. J. E. R.

4194. Striated Positive Column. Part I. Pure Hydrogen. A. Güntherschulze and H. Meinhardt. *Zeits. f. Physik*, 110. 1-2. pp. 95-117, 1938.—The current strength for which the unstriated discharge passes over to the striated discharge can be measured very accurately. It is found to be an exponential function of the pressure. From this function it is seen that the striated discharge in pure H_2 should be possible when the current strength is high enough to build up a space charge which accelerates the electrons up to about six free path lengths and gives ample ionisation. With further increase of current strength the layer distance and layer p.d. rapidly decreases, for which an explanation is given. For another quite definite and measurable current strength the uniformly striated discharge suddenly becomes non-uniform and pairs of striae occur. The current strength at which this occurs follows very closely the law $i = C.p^3$. With still further increase of current strength there is a gradual change to a different type of single striae. Illustrations are given of the effects obtained under various conditions of current and pressure in tubes of carefully prepared pure H_2 . A. W.

4195. Influence of Tube Diameter on Concentration of Excited States in the Positive Column. W. Dirbach and K. Krebs. *Zeits. f. Physik*, 110. 1-2. pp. 134-144, 1938.—A neon discharge tube of varying diameter has been used to estimate by a previous method [see Abstract 4183 (1936)] the concentration of harmonic oscillators of different frequencies. The concentration increases with decreasing diameter and this, in conjunction with minor corrections, accounts for earlier discrepancies. G. C. E.

4196. Influence of the Ramsauer Effect on the Potential Gradient in a Positive Column. B. Klarfeld. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 6-7. pp. 471-474, 1938. In English.—Discharges in He, Ne, A, Kr, Hg vapour and K vapour were investigated to find out how the potential gradient in the positive column varies with pressure in general. The gradient was measured by the zero-current probe method in tubes of 20 mm. dia., the discharge currents ranging from 25 to 300 mA. The results obtained for He, Ne, A and Kr with a current of 0.3 A are qualitatively similar and change continuously in one direction on passing from the light to the heavier inert gases. The gradient minimum, at pressures of about 1 mm. of Hg, is deeper in the heavier rare gases. This fact may possibly be attributed to the Ramsauer effect, which is more pronounced in the heavier rare gases. Calculated gradients for He and A agree fairly well with the observed gradients. The absence of a gradient minimum in He and in K vapour may possibly be connected with a decrease of the effective cross-section of He and K atoms with increasing electron velocity. In Hg vapour a slight minimum of the potential gradient is observed. It is pointed out that earlier measurements of the potential gradient and of the values of T_e and B in Hg vapour would be in better agreement if for Hg there existed a Ramsauer effect for electrons of very low velocities. [See also Abstract 2754 (1937).] A. W.

4197. Characteristics of Glow to Arc Transition in Mercury Vapour. F. A. Maxfield and G. L. Fredendall. *J. of Applied Physics*, 9. pp. 600-610, Sept., 1938.—The probability of the transition from glow discharge to arc discharge at graphite electrodes has been investigated under carefully controlled cathode conditions. The transition probability was found to increase in an approximately linear fashion with an increase in cathode current density and glow voltage. The curve of transition probability as a function of cathode temperature was found to have a distinct maximum at a temperature of about 400° or 450° C. The probability of the transition occurring at temperatures 50° lower or higher was not more than about one-fourth the maximum. It was also found that the frequency with which the glow to arc transitions occurred depended greatly on the previous history of the discharge and the amount of high voltage positive ion bombardment experienced by the cathode under test. A possible explanation of these results has been based on the hypothesis that it is never possible to de-gas completely the cathode electrode even after prolonged operation in a high voltage discharge. It has been shown that the non-uniform emission of this gas from the cathode in the form of bursts from minute patches can lead to a greatly increased probability for transition from glow to arc. AUTHORS.

4198. Excitation of Metastable Atoms in a Gas Discharge. V. Fabrikant. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 385-388, 1938. *In English.*—Continuing previous work [see Abstracts 4567 (1937) and 1307 (1938)] an attempt is made to evolve a general theory of the excitation of atoms in the gas discharge. Two limiting cases are considered, the first corresponding to the destruction of metastable states by various mixtures and the second to discharges with high current densities in pure vapours and gases. Agreement between theory and experiment is satisfactory. [See following Abstract.] F. C. C.

4199. Excitation of Radiating Atoms in a Gas Discharge. V. Fabrikant. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 389-392, 1938. *In English.*—The results [see preceding Abstract] on metastable atoms are applied to radiating atoms. The latter are also influenced by diffusion so that extension of the theory is only approximate. However, it is found possible to draw several conclusions on the influence of discharge conditions upon the excitation of radiating atoms. For example, it is shown that the "prisoning" of radiation is one of the main factors determining the quenching of radiating atoms in a discharge. F. C. C.

4200. Relativity Corrections for the Ionisation Potential of Atoms with Two Electrons. H. A. S. Eriksson. *Zeits. f. Physik*, 109. 11-12. pp. 762-773, 1938.—The relativity corrections for the ionisation potential of an atom consisting of a nucleus of arbitrary atomic number Z and two electrons is given in the form of an expansion in powers of $1/Z$. For $Z = 2$ and 3 (He I and Li II) this formula converges too slowly and is replaced by a numerical evaluation. The results are in satisfactory agreement with experiment. R. P.

4201. Transverse Field for Positive and Neutral Rays. E. Persico and A. Rostagni. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 363-368, April-June, 1938.—The mathematical results obtained in previous work [see Abstract 1272 (1938)] are applied to the experimental work of the author and others. Qualitative, and in some cases, quantitative agreement is obtained. F. C. C.

4202. Interference of Light from Canal Rays. H. Billing. *Ann. d. Physik*, 32, 7, pp. 577-592, Aug., 1938.—An apparatus is described for producing a visible canal ray consisting of a homogeneous beam of H_2^+ ions. Interferometric observations with a Fabry-Perot instrument which is arranged to view the discharge in a longitudinal direction show that interference is obtainable from two different points of the canal ray. The classical wave theory is capable of giving a quantitative explanation although wave-mechanical principles are not violated. H. J. H. S.

***4203. Gas Current H.V. Generators.** M. Pauthenier. *Comptes Rendus*, 207, pp. 126-129, July, 11, 1938.—The results hitherto obtained are discussed, and an improved arrangement, especially of the elbows of the tubes, sketched, by which it is hoped to obtain several kilowatts at 2 mV. [See Abstracts 2543 and 2975 (1938).] C. A. S.

See also Abstracts 3961, 4064, 4065, 4066, 4067, 4068, 4160, 4232 and 2878B. Emission of Light in the Positive Column at Low Pressure. W. Uytendhoeven.

CONDUCTION IN SOLIDS AND LIQUIDS.

4204. Effect of Cold Working and Heat Treatment on the Electric and Magnetic Properties of Pure Nickel. Part II. Twisted and Stretched Nickel. H. Bittel. *Ann. d. Physik*, 32, 7, pp. 608-624, Aug., 1938.—A report of measurements of resistance and magnetisation of wires of carbonyl nickel subjected to elastic and plastic deformation and to different heat treatments. Among the results given are the following. Elastic torsion increases the resistance, but if the torsion takes place in a strong enough field, the change of resistance is very small. If the wire is twisted in a weaker field, there may be an increase or decrease of resistance depending on the field strength. The effect can be explained on Becker's theory. The change of resistance in parallel and perpendicular fields was observed in wires twisted elastically and plastically; plastic torsion does not produce magnetic anisotropy. In contrast to the effect caused by other modes of cold working, the specific resistance is very little changed by plastic torsion. After cold working, recovery of magnetic and electric properties begins at the same temperature. The temperature of recovery is lowered by additional cold working. [For Part I see Abstract 1709 (1938).] G. E. A.

4205. Coexistence of Normal and Supraconductive Regions. K. Mendelssohn and J. G. Daunt. *Phil. Mag.*, 26, pp. 376-380, Sept., 1938.—It is shown that an isothermal coexistence of supraconductive and normal material can occur in the same specimen. The time effects in supraconductors are discussed with regard to such a coexistence.

AUTHORS.

4206. Conductivity of Transition Metals. A. H. Wilson. *Roy. Soc., Proc.*, 167A, pp. 580-593, Sept. 23, 1938.—By using a model in which the energy surfaces are spheres, a complete theory is worked out of the s - d transitions in a metal containing incomplete d -bands. The results are of the same order of magnitude as those given by Mott's qualitative theory, but differ considerably in detail and in interpretation. It is shown that the s - d transitions should fall off exponentially as the temperature is lowered. A suggestion is put forward to explain the change in sign of the thermoelectric power of Pt at low temperatures. AUTHOR.

4207. Conductivity and Dielectric Constants of Crystals. M. G. Rahimi. *J. de Physique et le Radium*, 9. pp. 291-296, July, 1938.—In measuring the conductivities the Curie electrometer was used; the crystal was placed in an electric furnace suitable for the gradual raising of the temperature. This temperature was measured by means of a thermocouple. Quartz slabs cut perpendicular and parallel to the axis were studied. In the case of the perpendicularly cut slabs a prolonged heating at 700° C. greatly diminishes the conductivity shown by the crystal in the cold, and this diminution is still greater if the crystal remains under tension whilst being heated. By coating the crystals with Pd, Pt or Ag a condenser arrangement could be set up for the study of the dielectric capacity. Different methods—electrostatic, electromagnetic, and resonance—were used to measure the dielectric constant. The heat treatment seems to make various anomalies in the dielectric properties of quartz disappear. The thermal and electrical treatment also seems to cause quartz to assume a more well-defined state. Other crystals, including those of rock salt, were studied with similar results. G. G.

***4208. Micro-Method for Measuring Specific Conductance.** P. A. Walker. *Science*, 88. pp. 63-64, July 15, 1938.—An apparatus is designed for the measurement of specific conductances of extra-embryonic fluids of the developing chick. The apparatus is constructed of tubing 0.3 cm. internal dia., made of Jena glass. The electrodes consist of tight coils of Pt wire, having an area of about 1 mm². Conductances can be measured with as little as 0.1 cm³. The cell was standardised by measuring the conductance of 0.1 N KCl. After correction of the results for polarisation the percentage error was found to be 0.346%. F. J. B.

See also Abstracts 3904, 3905, 3906, 4168, 4233.

DIELECTRICS AND CAPACITANCE.

***4209. Molecular Models of Dielectrics.** L. Hartshorn. *Phys. Soc., Proc.* 50. pp. 852-855, Sept. 1, 1938.—Describes a cheap and simple method of construction of molecular models of complicated organic compounds such as the synthetic resins. The units of the structure are made from commercial "ball-feet" which merely require drilling in a simple jig. Models of phenol-formaldehyde resins, polystyrene and chlorinated rubber are illustrated. L. H.

4210. Dipole Moments of Vapours. Part VII. L. G. Groves. *Chem. Soc., J.* pp. 1195-1196, Aug., 1938.—On the basis of values for the moments of the C-Cl and the C-H link obtained from the moment of methyl chloride, it is shown, after allowances are made for components of induction, that the Cl-C-Cl intercovalency angle is approximately tetrahedral in both chloroform and methylene chloride. This result is in accord with the electron-diffraction results of Sutton and Brockway [see Abstract 1908 (1935)]. [For Part VI see Abstract 829 (1938).] AUTHOR.

4211. Change in Dielectric Constant at Freezing Point of Homopolar Liquids. R. Guillen. *Comptes Rendus*, 207. pp. 393-395, Aug. 17, 1938.—The dielectric constant of N₂ was plotted against temperature for the interval 55-80° K. It steadily increases as temperature falls, from 1.4318 at 78° K. to 1.4746 at 63.3° K.; then increases suddenly, in freezing, to 1.514, after which it increases slowly as temperature falls further. The apparent decrease in that of the solid as tempera-

ture falls is due to contraction of the solid between the armatures of the condenser. [See Abstract 1521 (1927).] C. A. S.

4212. Dielectric Constant of Pure Organic Liquids. R. J. W. Lé Fèvre. *Faraday Soc., Trans.* 34, pp. 1127-1132, Sept., 1938.—A convenient type of apparatus for dielectric constant measurements at various temperatures is described, results recorded, and the experimental indication noted that all liquids apparently have roughly the same dielectric constant at their critical points.

4213. Dipole Moments and Molecular Structure. E. Bergmann and A. Weizmann. *Am. Chem. Soc., J.* 60, pp. 1801-1804, Aug., 1938.—Dipole moment measurements reveal that the addition of chlorine to 1,5-dichloroanthracene and 9,10-diphenylanthracene is a *cis* reaction; it is suggested that, in contradistinction to the usual behaviour, the chlorine molecule is added. 1,8-Dichloroanthracene adds chlorine in *trans* reaction. The splitting reactions of anthracene-9,10-dihalides show no recognisable regularity. Hydrolysis of 1,5-dichloroanthracene-9,10-dibromide, is accompanied, at least partially, by Walden inversion; the dipole moment of the corresponding *cis* diol has been measured. On the basis of the dipole moments, the spatial arrangement of the isomeric dimethyl 9,10-dihydroanthracene-9,10-dicarboxylates has been determined. AUTHORS.

See also Abstract 4207.

ELECTROCHEMISTRY.

4214. Active Aluminium Obtained by Electrolysis at Elevated Temperature. A. Chrétien and J. Bisch. *Comptes Rendus*, 207, pp. 237-239, July 18, 1938.—Al in an extremely active form was obtained by the electrolysis of aluminium potassium bromide, using a Hg kathode. The electrolysis was carried out in a steel bomb under pressure. This was necessary owing to the boiling point of aluminium bromide being 270° C., and the electrolysis was carried out at 500° C. After the electrolysis had proceeded for 1 hr. the Hg was removed from the apparatus and divided into two portions. One portion, exposed to carefully dried air, became covered with a layer of alumina in light flakes, the other portion, under the action of water, separated a deposit of alumina in an extremely fine state of division. F. J. B.

4215. Electrolytic Dissociation of Cadmium Iodide. Y. Doucet. *Comptes Rendus*, 207, pp. 362-364, Aug. 8, 1938.—The lowering of the freezing point of molten $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ by CdI_2 has been investigated. The curve of molecular depression against the molarity (M) of the solution falls rapidly as M increases. Extrapolation gives a limiting molecular depression equal to twice the value for the solvent so that there would be dissociation into two ions at fairly high concentrations. The results were verified by determining the e.m.f. of the cell $\text{CdHg}|\text{CdSO}_4, \text{MgSO}_4|\text{KCl sat.}|\text{CdI}_2, \text{CaCl}_2|\text{CdHg}$. A cryoscopic investigation of the $\text{KNO}_3, \text{H}_2\text{O}, \text{CdI}_2$ system has also been made. The conclusion is reached that CdI_2 probably exists in solutions of medium concentration as Cd^{++} and $(\text{CdI}_4)^{-}$ ions, but in dilute solution it dissociates into six ions corresponding to the formula CdI_4 . A. J. M.

4216. Exchange Forces and Electrostatic Forces between Ions in Solution. R. W. Gurney. *J. Chem. Phys.* 6, pp. 499-505, Sept., 1938.—Though the treatment of ionic dissociation by thermodynamic methods has been fruitful, the mechanism can be better understood by

the use of statistical mechanics. For this purpose one needs to know the potential energy of the ions as a function of temperature. The work D required to dissociate a molecule or molecular ion consists of two parts, one part D_{el} due to electrostatic forces, and the other D_{non} due to non-electrostatic forces. As the former varies rapidly with temperature, for each species the value of dD/dT is a guide to the value of D_{el} . It is shown that for acid molecules and molecular ions in aqueous solution the relative values of dD/dT for different types are in the order predicted. Further, the characteristic temperature θ at which the dissociation constant passes through a maximum should depend, not on the value of D , but on the relative magnitudes of D_{non} and D_{el} . It is found that the known values of θ fall into line in accordance with this rule. Between two Hg^+ ions, or two Te^- ions, there will be exchange forces of attraction similar to those which give rise to the molecules Na_2 and Br_2 ; thus in aqueous solution the ions $(Hg_2)^{++}$ and $(Te_2)^{--}$ are stable, although for them D_{el} is negative.

AUTHOR.

4217. Electrostatic Influence of Substituents on Dissociation Constants of Organic Acids. Parts I and II. J. G. Kirkwood and F. H. Westheimer. *J. Chem. Phys.* 6, pp. 506-517, Sept., 1938.—In

Part I Bjerrum's theory of the influence of substituents on dissociation constants has been extended and amplified. The molecules and ions entering into the ionisation equilibria are treated as cavities of low dielectric constant, rather than as structureless regions of the same dielectric constant as the solvent. The theory gives better results than the simple Bjerrum formulation, especially for the short chain dicarboxylic acids, and in the fact that it permits a satisfactory treatment of the influence of dipolar substituents on dissociation constants. In Part II the theory of the influence of substituents on dissociation constants is extended to acids ellipsoidal in shape. Bjerrum's formula is obtained in the limiting case of unit eccentricity of the elliptical section of a prolate ellipsoid of revolution. The influence of dipolar as well as ionic substituents can satisfactorily be treated.

AUTHORS.

4218. Influence of Degree of Ionisation on Structure of Belby Layer—Electrolyte Passage. F. J. Taboury. *Comptes Rendus*, 207, pp. 138-140, July 11, 1938.—The influence as regards the discharge curves of the degree of ionisation of the electrolyte in which this passage layer is plunged, is discussed. The effect of conductivity water is approximately the same as that of concentrated H_2SO_4 , both being practically non-ionised. This effect differs greatly from that of the almost completely ionised dilute H_2SO_4 . The extent of this influence varies at approximately the same rate as the degree of ionisation as indicated by the Raman spectrum. [See Abstract 3826 (1938).]

C. A. S.

4219. Effects of Solvents on Polarographic Wave Heights. E. S. Peracchio and V. W. Meloche. *Am. Chem. Soc., J.* 60, pp. 1770-1775, Aug., 1938.—Polarograms are shown for $NaCl$, KCl , $RbCl$ and $CsCl$ in aqueous solutions and differences in wave height are shown to exist for equivalent concentrations of the chlorides. Contrary to indications in the literature, it is shown that equivalent concentrations of $CdCl_2$, $BiCl_3$, and $PbCl_2$ do not give equal wave heights. It is shown that the presence of various alcohols lowers the wave heights exhibited in aqueous solutions. Differences between the wave heights for equivalent concentrations of alkali chlorides are lessened. Addition of certain polyhydric alcohols to aqueous solutions of the alkali chlorides also lowered the wave heights

but in cases of the more viscous solutions the curves were poorly defined. When dioxane was added to aqueous solutions of the alkali chlorides, the wave heights for equivalent concentrations of the salts were the same. Although the shape of the curves was not ideal, the wave heights could be measured and the curves were suitable for quantitative analysis. While the universal use of organic solvents in solutions prepared for the polarograph is not recommended, there are many cases where the use of such systems is desirable and in some cases even mandatory. **AUTHORS.**

4220. Adsorption and Desorption of Hydrogen at Platinum Electrodes. J. D. Pearson and J. A. V. Butler. *Faraday Soc., Trans.* 34. pp. 1163-1170, Sept., 1938.—The changes of potential of Pt electrodes on anodic and cathodic polarisation have been investigated with high current densities using a kathode-ray oscillograph. At active electrodes it is shown that an adsorbed film of atomic H is formed prior to the liberation of H_2 at the kathode, and is removed by anodic treatment at potentials more positive than the reversible H_2 -potential. [See also Abstract 5267 (1936).] **AUTHORS.**

4221. Potential of Cd/Cd⁺⁺ in Very Dilute Solutions. F. Müller and W. Dürichen. *Zeits. f. phys. Chem.* 182. Abt. A. 4. pp. 233-242, 1938.—It is pointed out that previous work on the determination of the potential of Cd electrodes in very dilute solutions of Cd salts may have been vitiated by the fact that air was not rigorously excluded from the electrodes. Absorbed O_2 can set up local action, $Cd(OH)_2$ being formed, giving rise to Cd⁺⁺ in the solution, and hence an incorrect electrode potential. The potential has now been determined with Cd electrodes specially purified in a high vacuum. The concentration of the $CdSO_4$ solutions used was from 1 to 10^{-7} gm.-equivalents/l. **A. J. M.**

4222. Flow Phenomena at Mercury Kathodes. M. v. Stackelberg, H. J. Antweiler and L. Kieselbach. *Zeits. f. Elektrochem.* 44. pp. 663-673; *Disc.*, 674, Sept., 1938.—Flow phenomena at static Hg kathodes are investigated in connection with polarographic maxima. Such flows occur when an easily reducible substance is electrolysed in the presence of a kation which is reducible with difficulty. A tangential force to the flow is found to act at the kathode surface in a direction determined by the current density and the signs of the charges on the kathode double layer. Variations in electrolyte concentration have been shown to produce corresponding variations of the kathode potential. The phenomena are explained by the aid of current-tension curves and kathode potential tension curves. The discussion deals mainly with experimental technique. **H. H. Ho.**

See also Abstracts 3899, 3920, 4178, 4179.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

4223. New Precision Method for the Determination of e/m for Electrons. A. E. Shaw. *Phys. Rev.* 54. pp. 193-209, Aug. 1, 1938.—Crossed electric and magnetic fields have been used in a method which effectively eliminates the influence of electron energy on the value of e/m. Errors due to charging of the slits which may rise to 24 V are thus avoided and e/ m_0 is found to be $(1.7571 \pm 0.0013) \times 10^{-7}$ e.m.u. The mechanical accuracy of the cylindrical condenser sets the precision limit and it is estimated that by proper design the error could be reduced to 1:3000. **G. C. E.**

4224. Motion of an Electrified Corpuscle in Presence of a Magnetic Dipole. C. Agostinelli. *Accad. Sci. Torino, Atti*, 73. *Disp.* 3a. pp. 460-474, April-June, 1938.—The problem of the motion of an electrified corpuscle in presence of a magnetic dipole is considered, a problem closely connected with the theory of the aurora borealis. A new integral is developed first of all of the equations of motion and then the problem is reduced to that of the plane motion of a point acted on by a conservative force which is independent of the time. Finally a notable particular case is considered in which the problem is integrated by the method of the separation of the variables. J. J. S.

4225. Atomic Electron Velocities in Hydrogen. A. L. Hughes and M. A. Starr. *Phys. Rev.* 54. pp. 189-193, Aug. 1, 1938.—The distribution of energies among the electrons scattered inelastically by atomic electrons is determined by the distribution of energies among the latter in such a way that the curve representing the distribution of energies among the scattered electrons, above or below the most probable value, is identical in shape with the distribution of the component velocities among the atomic electrons. The latter distribution was found for energies between 1737 and 4040 eV in hydrogen for $\theta = 34.2^\circ$. The experimental curve is wider than the theoretical curve computed by Hicks by about 11% at the half-width and it is suggested that the theoretical assumptions may have to be modified. G. C. E.

4226. Neutron Scattering Cross-Sections. F. G. Brickwedde, J. R. Dunning, H. J. Hoge and J. H. Manley. *Phys. Rev.* 54. pp. 266-275, Aug. 15, 1938.—Measurements have been made of the transmission of liquid *p*- and *o*-H₂ for the slow neutrons obtained from a Rn-Be source by scattering in paraffin. As the neutrons captured by protons were less than 1% of the scattered neutrons, the scattering by the thin layers of liquid H₂ was determined from transmission measurements. The scattering cross-section of liquid H₂ for slow neutrons was found to depend on the velocity of the neutrons and on the ortho-para composition of the H₂. Two neutron energies were used,—approximately 120° K. and 300° K. Values for the cross-sections at these velocities are given. It is shown that the interaction between neutrons and protons is dependent on the relative alignment of their spins, and that the singlet state of the deuteron is virtual. Values for the cross-section for capture and scattering together are given for N₂, O₂ and H₂O. G. O. B.

4227. Electron Diffraction by Split-Shutter and Back-Reflection Methods. R. Jackson and A. G. Quarrell. *Phys. Soc., Proc.* 50. pp. 776-782, Sept. 1, 1938.—The necessity for using the grazing-incidence method when electron-diffraction is applied to the study of surface structure is emphasised, and precautions to be taken in order to obtain the maximum information from the patterns are discussed. A satisfactory method for obtaining comparison reflection patterns by the split-shutter method is described, and details of a light-tight split-shutter plate-holder are given. In view of the limitations of the grazing-incidence method the possibility of the back-reflection of electrons is considered, and experiments are described in which high-speed electrons diffracted through angles approaching 180° are recorded photographically, the incident beam being normal to the surface of the specimen. The results obtained do not enable definite conclusions to be drawn concerning the two-dimensional or three-dimensional nature of the mechanism of diffraction involved, but development of the technique should result in a useful method applicable to those

specimens which cannot at present be directly examined by electron-diffraction.

***4228. Electron-Scan Microscope. Theoretical Fundamentals.** M. v. Ardenne. *Zeits. f. Physik*, 109, 9-10, pp. 553-572, 1938.—In a previous publication [see Abstract 2160 (1938)] it was pointed out that one of the main factors limiting the resolution of the electron microscope is the chromatic aberration arising from the variable velocity control of electrons in the object layer and object supporting foil. This form of chromatic aberration has been successfully eliminated in a new type of electron microscope devised by the author and termed the electron-scan microscope (*Elektronen-Rastermikroskop*). In this the object to be examined is explored by an electron-probe comprising an electron beam focused to an exceedingly fine point; the electron-probe is scanned over the object surface and by means of suitable electron detectors the scattering of electrons by each element of the object is determined and the fine structure of the object is pictorially reproduced. Suitable electron detectors are secondary emission multipliers, point-counter tubes, collector-electrodes coupled with valve amplifiers, and photographic layers. Besides the absence of chromatic error the electron-scan microscope has the advantage over the electron microscope that it can be applied to the examination of objects in free air; in this case the electron beam is scanned over the object through a Lenard window which serves as a support for the object. Practical details of construction of the microscope together with details of the practical results attained are reserved for a later communication.

J. E. K.

***4229. Short Magnetic Lens with Small Spherical Aberration.** W. Glaser. *Zeits. f. Physik*, 109, 11-12, pp. 700-721, 1938.—Simple expressions are derived for the spherical aberration of short electric and magnetic lenses and from these a short magnetic lens of minimum aberration is calculated. Numerical values of the radius of the diverging component are derived for a number of different fields.

H. J. H. S.

***4230. Simple Electron Microscopes.** R. P. Johnson. *J. of Applied Physics*, 9, pp. 508-516, Aug., 1938.—A brief description is given of a few of the simplest types of vacuum device which have been used by various investigators to produce images of metal surfaces by means of emitted electrons. These devices comprise essentially an electron emitting cathode and a fluorescent anode, the image on the anode is simply a projection of the cathode surface and the magnification depends on the geometrical disposition of cathode and anode. Examples are given of experimental results obtained with various geometrical arrangements, namely with cathode and anode as parallel planes, coaxial cylinders and concentric spheres. The devices described are not electron microscopes in the sense in which this term is normally applied inasmuch as they contain no electron-optical lenses for producing the image.

J. E. K.

***4231. Present Position of the Supermicroscope.** B. v. Borries and E. Ruska. *V.D.I.* 82, pp. 937-941, Aug. 6, 1938.—The development of the high power electron microscope since 1935 is briefly reviewed. The chief advances in its application have been made in the fields of bacteriology and colloid chemistry. L. Marton first entered the field of bacteriology and produced photographs of bacilli under magnifications of 750 diameters whilst later workers have increased this figure to some 20,000 diameters. Colloids of different types have also been examined under these high

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magnifications. Applications have also been made in the fields of colour chemistry, medicine, biology, and soil physics. Illustrations are given of each of these applications. H. J. H. S.

*4232. Action of a Proton Tube. T. Franzini. *Accad. Lincei, Atti*, 27. pp. 292-297, March 20, 1938. [See also Abstracts 3455 and 3908 (1934).]

See also Abstracts 3956, 4053, 4078, 4079, 4161, 4196, 4198, 4199, and 2911B. Apparatus for Measuring Scanning Speeds of Kathode-Ray Tubes, L. Blok.

ELECTROSTATICS.

See Abstracts 4203, 4266.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4233. Conductivity of Lead Crystals at Low Temperatures in Strong Transverse Magnetic Fields. E. Justi and H. Scheffers. *Phys. Zeits.* 39. pp. 591-597, Aug. 15, 1938.—A method similar to that previously employed for Au, Al and W [see Abstracts 306 and 1732 (1938)] is now extended down to 1.8° K. to determine the effect of a transverse magnetic field, ranging up to 31 kGauss on the electrical resistances of two lead crystals. Whereas with W, application of the field had caused a considerable increase in resistance at 14° K., with Pb it is necessary to go to liquid He temperatures before this effect becomes very pronounced. The difference is attributed to the small characteristic temperature (88° K.) of Pb. The increase in resistance again depends on the angle the field makes with the crystallographic axis, whilst as for the other crystals studied the mean relative increase in resistance due to the field is a function of the ratio of the field strength to the resistance in the absence of the field. R. W. P.

4234. Thermomagnetic Anomaly at Ordinary Temperatures in Microcrystalline Ferromagnetic Substances. A. Michel and M. Gallissot. *Comptes Rendus*, 207. pp. 140-142, July 11, 1938.—To explain the anomaly in the magnetisation temperature curves of various ferromagnetic substances (Fe_3O_4 , various ferrites, etc.) according to the state of crystallisation, it is suggested that the Curie points of the minute crystallites in the microcrystalline varieties vary, being lower the smaller the crystallite, but always above 20° C., below which the normal law is followed. A hyperbolic form of curve may be due to physical as well as to chemical heterogeneity. [See Abstract 2818 (1937).] C. A. S.

See also Abstracts 4204, 4243.

MAGNETISM AND ELECTROMAGNETISM.

4235. Phase of Magnetic Field. K. F. Niessen. *Physica*, 5. pp. 769-774, Aug., 1938. In German.—A correction is made relating to the phase of a magnetic field in two important works on electric waves, viz., F. v. Mises' *Differentialgleichungen der Physik* and H. M. Macdonald's *Electric Waves*. H. J. H. S.

4236. Permanent-Magnet Alloys of Co, Cu and Ni. W. Dannöhl and H. Neumann. *Zeits. f. Metallkunde*, 30. pp. 217-231, July, 1938.—The phase diagram of the ternary system Co-Cu-Ni is determined by measurements of the thermal, microscopic, electrical and mechanical properties of a number of alloys of the system. The effect of different thermal treatments on the magnetic qualities is described and particular

emphasis is laid on the large effect of annealing time. Under optimum conditions, the alloys of this system have coercive forces of 100–1000 Oe and remanences of 7000–2000 G. The highest coercivity is observed in the alloy containing 20% Co, 60% Cu and 20% Ni but the alloy with the highest $BH_{\max}$ value has a smaller Cu content (41% Co, 35% Cu and 24% Ni). These alloys are relatively easy to work and in this respect are far superior to alloys of the Fe-Ni-Al and Fe-Co-Ni-Ti systems. The magnetic properties under optimum conditions of five alloys of the system are described in detail.

H. J. H. S.

4237. Time Effects in Magnetisation. J. L. Snoek. *Physica*, 5, pp. 663–688, Aug., 1938. *In English*.—The influence of time in magnetisation manifests itself in three ways, *viz.*, magnetic viscosity, a reversible decrease of permeability and an irreversible decrease of permeability (magnetic ageing). A new theory is proposed to explain magnetic viscosity and the reversible time decrease of permeability. Experiments performed to test the theoretical deductions give good agreement, although the theoretical treatment does not cover the Jordan phenomena at higher frequencies. The basic assumption made is that the two time effects are related to a condition of strain existing in the barrier layer with respect to its immediate surroundings.

H. J. H. S.

4238. Magnetic Properties of Thin Evaporated Iron Layers. K. R. Dixit. *Phys. Zeits.* 39, pp. 580–582, Aug. 1, 1938.—Experiments on films of Fe on mica show that the thickness of the film profoundly modifies the physical properties. A film of 1.1×10^{-5} cm. thickness oxidised in a few hours whilst one of 3×10^{-6} cm. thickness showed little change after 4 months. The electrical resistance of a film of 2×10^{-6} cm. thickness was approximately that calculated whilst for one of 10^{-6} cm. thickness the resistance was about 10^7 times greater than the calculated value. Films which are thicker than 200 atoms show magnetic isotropy whilst thinner ones exhibit anisotropy.

H. J. H. S.

4239. Magnetic Anisotropy in Ferromagnetic Crystals in Weak Fields. Parts II and III. E. Kondorsky. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19, 5, pp. 397–404, 1938. *In English*.—In Part II the theory of the reversible susceptibility of ferromagnetic crystals first introduced by Gans is discussed for the case of weak fields. The processes which take place during magnetisation are described and from these the theory is built up. Formulae are finally derived giving the reversible susceptibility. In Part III the reversible susceptibility of Fe crystals in various crystallographic directions is calculated from the formulae already derived. The cases corresponding to a magnetic field parallel to (a) the direction [100], (b) the axis [110] and (c) the axis [111] are worked out. [For Part I see Abstract 3845 (1938).]

H. J. H. S.

4240. Break in Magnetisation Curve of Iron Monocrystals in Weak Magnetic Fields. K. Honda and T. Nishina. *Zeits. f. Physik*, 109, 11–12, pp. 758–761, 1938.—The magnetisation curves of long monocrystal rods of iron, each grown in one of the main crystallographic directions, are measured with an astatic magnetometer of high sensitivity. It is found that the beginning of the magnetisation curve is a straight line through the origin, which is identical for all orientations. For each orientation there is a certain point at which the slope of the curve suddenly increases. The significance of this fact is discussed.

R. P.

4241. Anomaly of Magnetite at Low Temperatures. R. Forrer. *Comptes Rendus*, 207, pp. 281–283, July 25, 1938.—The two existent

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species of magnetite can be distinguished chemically by the action of chlorine and physically by their magnetic behaviour at low temperatures. The species which does not add chlorine, and natural magnetite, show an increase in magnetisation at about -138° , whilst the second species, which adds chlorine, does not show this anomaly. The anomaly appears to result from the rupture of a bond between two divalent Fe atoms situated at a distance of $3.64 \text{ \AA}$, each being attached to four O atoms. The anomaly has not been found with the ferrites in which the divalent Ni or Mg are already saturated by O_2 . W. R. A.

4242. Effect of Pressure on the Curie Temperature. H. Ebert and A. Kussmann. *Phys. Zeits.* 39, pp. 598-605, Aug. 15, 1938.—An investigation of the space-diagram magnetisation-pressure-temperature (I_s, p, T) as dependent on pressure up to 4000 kg./cm^2 in the case of alloys of Ni-Al and Ni-Fe, with the object of connecting the Curie temperature with the atomic distance in the solution. At low temperatures, the effect of pressure on magnetisation diminishes. At high temperatures up to the Curie point, the effect of pressure on magnetisation increases, but with increased pressure diminishes, and the effect is the more marked the nearer the temperature to the Curie point. From the non-linear character of the I_s, p curves, it is concluded from extrapolation that the I_s, p, T surface approaches the p, T plane asymptotically, i.e., that no finite pressure can reduce the ferromagnetism to zero. This is in line with the statement that the Curie temperature is unaltered by pressure. G. E. A.

4243. Magnetically Orientated Bismuth. A. Altma. *Ann. d. Physik*, 32, 6, pp. 489-506, July, 1938.—Particles of Bi powder were allowed to fall in a magnetic field. These orientated themselves with their chief crystallographic axis in the direction of the field, and a column of powder obtained in this way was compressed into a briquet having the anisotropy of the Bi crystal and acting as an artificial single crystal. The anisotropy of the Bi powder was measured in terms of $\rho_{\max}$ and D , where $\rho_{\max}$ is the ratio of the maximum periodic change of resistance to the non-periodic change, and D is a measure of the moment of the directing couple on a 10 gm. mass of powder in a field of $10,000$ gauss. These quantities are, for the single crystal, annealed powder and unannealed powder respectively: $\rho_{\max}$ 89, 42 and 19; D 7500, 4420 and 2640. A method is described by which the course of recrystallisation can be followed. Another method is given for making orientated single crystals in a vacuum without the aid of a starting crystal. G. E. A.

4244. Paramagnetic Dispersion in Chromium Alum and Its Interpretation. C. J. Gorter, P. Teunissen and F. Brons. *Physica*, 5, pp. 657-662, Aug., 1938. *In English*.—The decrease in the h.f. paramagnetic susceptibility of chrome alum in a strong parallel magnetic field is further studied [see Abstract 4208 (1937)], and the paramagnetic dispersion is shown in graphs of χ/χ_0 against the frequency of the alternating field, for temperatures 77.4°Abs. and 90.2°Abs. , and in fields of 800 to 3200 Oe. The results are compared with the theoretical considerations of Kronig and Casimir. G. E. A.

4245. Magnetic Studies on Rhodochrosite, MnCO_3 . K. S. Krishnan and S. Banerjee. *Zeits. f. Krist.* 99, 6, pp. 499-508, 1938. *In English*.—The paper gives a report of measurements on the magnetic anisotropy, and on the mean susceptibility at different temperatures, of rhodochrosite (MnCO_3). The mean susceptibility of the crystal is of the

order of $12,000 \times 10^{-6}$ per gm. mol. of MnCO_3 at room-temperature, and its temperature variation conforms to the formula $\chi = 3.81/(T + 13)$, from which the magnetic moment of the Mn^{2+} ion comes out as 27.5 Weiss magnetons. The anisotropy of the crystal is very feeble, as should be expected, being about 7.2×10^{-6} per gm. mol. at room-temperature, which is only 0.06% of the mean susceptibility. This corresponds to a separation between adjacent levels in the Stark-pattern of Mn^{2+} , produced by the crystalline electric fields acting on it, of the order of 0.07 cm^{-1} .

AUTHORS.

4246. Magnetic Susceptibility of Au-Cu, Au-Ag, Ag-Cu and Cu-Ni Alloys. W. Broniewski, S. Franczak and R. Witkowski. *Ann. de Physique*, 10. pp. 5-19, July-Aug., 1938.—The magnetic susceptibility, χ , of Au-Cu (I), Au-Ag (II), Ag-Cu (III), and Cu-Ni (IV) alloys has been measured as a function of the composition by weight. The component metals were purified chemically or refined electrolytically and the preparation and subsequent treatment of the alloys were carried out *in vacuo* or in an atmosphere of H_2 . The diagram of (II), composed of continuous solid solutions, shows a curve slightly concave to the composition axis, whilst that of (III), formed of a mixture of weak solid solutions, approximates to a straight line. The diagram of (IV), composed of solid solutions, shows the continuous passage of paramagnetic to ferromagnetic alloys. The diagram of tempered (I), composed of continuous solid solutions, shows a curve similar to that of (II), but that of annealed (I) indicates the formation of the compounds Au-Cu and AuCu_3 . For certain alloys, e.g., (I), the χ curves enable the determination of structure which cannot be accomplished by other methods.

W. R. A.

4247. State of Ni in the α -Phase of Ni-Zn System. J. Dorfman and S. Sidorof. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 381-382, 1938. In English.—Using a modified Weiss balance the magnetic susceptibilities (χ) of five Ni-Zn alloys, containing from 16.1 to 20.25 atomic % of Bi, have been investigated at room-temperature. The samples represented almost pure γ -phases. For two samples χ is slightly diminished with increase of temperature but for the other three χ is temperature-independent. The γ -phase in Ni-Zn alloys possesses great diamagnetism and therefore the magnetic moment of the Ni atom is zero. The Ni is thus neutral and has its full complement of 28 electrons. This is in agreement with the Hume-Rothery rule relating to γ -phases.

W. R. A.

4248. Magnetic Susceptibility of Sm^{+++} Between 293 and 800°K . O. E. Frivold and L. Lunde. *Phys. Zeits.* 39. pp. 571-574, Aug. 1, 1938.—The mass susceptibility of Sm_2O_3 is given as a function of temperature as well as the ionic susceptibility of Sm^{+++} and the number of Bohr magnetons. The results for the relation between the number of Bohr magnetons and temperature agrees with that deduced theoretically on the assumption of a screening factor of 33.

H. J. H. S.

4249. Paramagnetic Relaxation. P. Debye. *Phys. Zeits.* 39. pp. 616-618, Aug. 15, 1938.—The relaxation time of an Fe ammonium alum was recently measured by de Haas and du Pré at the temperature of liquid He whilst Casimir and du Pré have derived a formula connecting susceptibility and frequency which is in agreement with experiment. The assumptions made by the latter are considered and a method is found for extending the argument to the more general case.

H. J. H. S.

See also Abstracts 3887, 3947.

MEDICAL RADIOLOGY AND ELECTROLOGY.

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4250. **Electronic Cardiograph.** J. W. Horton. *Electronics*, 11, pp. 14-17 and 55, Aug., 1938.—Thermionic valves have been applied in the investigation of the electrical currents related to the action of the normal and pathological heart, since the early work of P. Boaz and B. Liebowitz in 1928. The wave-form of the electrocardiograph, on analysis, gives information in respect to the energy distribution of the components, the fundamental component being determined by the heart rate and having a much greater fundamental frequency in mice than in the human subject. An 8-valve apparatus for such investigation is illustrated and described.

B. J. L.

4251. **Nomogram for Radiographic Mensuration.** H. J. Holmquest. *Radiology*, 31, pp. 198-205, Aug., 1938.—A nomographic chart has been constructed to facilitate the radiographic determination of linear dimensions, such as diameters, chords, or perimeters which lie in planes parallel to the film. From known and readily measured parameters, the diameter or perimeter of a radiographic image can be determined by means of the chart, without any calculations. The dimension obtained from the chart is the dimension of the projection from the focal spot of the object radiographed, on a plane passing through the centre of the object and parallel to the film. This dimension is somewhat greater than the corresponding dimension of the section of the body determined by the intersecting plane through the centre of the body and parallel to the film. However, for the anode film distances employed in radiography, it is shown by mathematical analysis that the error in dimension is negligible. The nomogram is constructed for anode-film distances of 10-84 in. and object-film distances of 0-30 cm. and it is effective for measured dimensions up to 75 cm.

T. A. C.

4252. **Kinematography by the Indirect Method.** R. Reynolds. *Radiology*, 31, pp. 177-182, Aug., 1938.—A historical survey is made of attempts to produce kinematographic records by means of X-rays, by the two possible methods. The direct method consists of exposing serially comparatively large films, the pictures being then reduced to normal size for projection purposes. In the indirect method an ordinary kinematographic apparatus with a wide-angle lens is used to photograph the X-ray shadow on a fluorescent screen. The author contends that as a result of improvements in recent years in tube and screen construction, and in photographic technique, the indirect method is now sufficiently practicable for ordinary hospital use. A short account of the method is given, together with examples of its use in the examination of moving joints, heart and gastro-intestinal tract.

J. E. R.

4253. **Stray Radiation Survey of X-Ray Installations.** C. B. Braestrup. *Radiology*, 31, pp. 206-213, Aug., 1938.—The first part of the survey deals with the stray radiation intensity in the immediate neighbourhood of a number of enclosed tube holders. It is shown that these normally provide sufficient protection for the patient; on the other hand, even when the shutters are closed the protection for operators during routine manipulations in the X-ray cubicle is usually inadequate. It is suggested that the term "ray-proof" for such tubes is ambiguous and should only be used for apparatus where the stray radiation is less than 0.036 r.hour at 1 m. focal distance. Details of more comprehensive stray radiation measurements on some 20 installations are given side by side with the protective arrangements in each case. It is shown that by

careful arrangement of protective materials, a high factor of safety can be obtained at a considerably reduced cost. Several cases of insufficient protection were corrected as a result of this survey. J. E. R.

*4254. **Concrete Protection against Hard X-Rays.** F. Heidenreich and R. Jaeger. *Phys. Zeits.* 39, pp. 541-546, July 15, 1938. From the Reichsanstalt.—A short description is given of the 800 kV generator and the 500 kV X-ray tube in use at the Reichsanstalt. Curves are given showing the relative protective powers of lead and concrete in the voltage range 150 to 500 kV for various filtrations. The ratio of thicknesses necessary to reduce the radiation to the tolerance dosage rate decreases from 80 to 15 in this voltage range. In view of this decrease, concrete is recommended as a protective material for hard radiations. The results are compared with a curve calculated by Rump for monochromatic radiations. J. E. R.

*4255. **γ -Ray Measurement.** W. Friedrich. *Am. J. of Roentgenology and Radium Therapy*, 40, pp. 69-79, July, 1938.—The difficulties of intensity measurement of γ -rays, are discussed in respect to the effects of the ionisation chamber wall material and thickness and scattered radiation. Large dimensions in barrel chambers have not led to consistent evaluations and, with small chambers, the wall thickness causes great variations. Measurements in this respect, with an apparatus illustrated, are given in large detail and show that measurements for isodosis curves for γ -rays in terms of röntgens, are only possible by use of an ionisation chamber of air equivalent material and sufficient wall thickness, after removal of the scattered γ -radiation. Under these specified conditions a value in "r" units is found of 7.8 r. per mg.-hr. B. J. L.

*4256. **γ -Ray Measurement.** G. W. C. Kaye and W. Binks. *Am. J. of Roentgenology and Radium Therapy*, 40, pp. 80-91, July, 1938.—The "r" unit of X-ray dosage is defined, for the measurement of which "free-air" and "air-wall" ionisation chambers are utilised. The use of this unit for the measurement of γ -rays is discussed and experience shows differences in measurements with free-air and air-wall chambers. A large free-air parallel-plate ionisation chamber is described and illustrated and measurements considered in respect to "natural" ionisation in such chambers, which show the measured ionisation of a γ -ray beam from a point source of 1 mg. of Ra filtered by 0.5 mm. of Pt over 1 hr. at 1 cm. distance equals 7.9 r. Results with air-wall chambers are then discussed, and with these, a value of 8.0 r. is obtained. The results are compared with the findings of other investigators, possible sources of error being discussed. The air-wall chamber in respect to clinical use has definite limitations when the chamber wall is thick but, in view of the fragility of thin wall chambers, they have definite practical application. A modification is suggested in respect to the present definition of the "r" unit. B. J. L.

See also Abstract

2947B. Life, Death and Short-Wave Radiation. S. G. Hibben.

OSCILLATIONS AND WAVES.

4257. **Triode Hysteresis.** A. Iskander. *Gerlands Beitr. z. Geophys.* 53, 4, pp. 277-284, 1938. In English.—With a view to geophysical applications the influence of periodic capacity variations on triode hysteresis is studied. AUTHOR.

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***4258. Stable-Frequency Valve Oscillators.** Y. Rocard. *J. de Physique et le Radium*, 9. pp. 237-240, June, 1938.—It is possible so to design a valve oscillator that the frequency is determined solely by the constants of the oscillating circuit and does not vary with the internal resistance of the valve. The method described by the author consists in putting the tuned circuit in the anode connection but putting in series in the grid and anode circuits impedances of suitable value. F. S. B.

***4259. Short-Wave Oscillator.** T. V. Ionescu. *Comptes Rendus*, 207. pp. 54-57, July 4, 1938.—This paper describes arrangements which have been used for the production of oscillations and gives a description of the appearance of the discharge in the tube under various conditions. A formula is given for the wave-length with some experimental results in verification. Depending on the size of tube, distance apart of plates, applied potentials, gas pressure and strength of field, waves between 12 cm. and 144 cm. have been generated. [See Abstract 3281 (1937).] F. S. B.

4260. Critical Frequency of Radio Waves Reflected Obliquely from the Ionosphere. F. T. Farmer, C. B. Childs and A. Cowle. *Phys. Soc., Proc.* 50. pp. 767-775, Sept. 1, 1938.—Experiments are described which compare the *F*-region skip frequency, for transmission between two distant stations, with that calculated from the normal-incidence characteristics on a simple ray theory. The greatest possible accuracy was aimed at so that the results might resolve an uncertainty left in previous measurements, in which the forms of the oblique and normal incidence *Pf* curves were compared. This involved using a pulse-transmitter at each end of the oblique trajectory to correct for horizontal variations of ionisation, and developing a special rapid technique. Measurements were confined to days when the ionosphere was in a completely undisturbed state, as shown by the clean splitting of echoes at normal incidence. The results showed that the theory, which neglects the earth's magnetic field, is very nearly correct for the ordinary wave over a transmission distance of about 500 km. The precise disagreement is determined, and it is believed that if an accurate theory be developed the results will indicate whether or not the Lorentz term should be included in the analysis.

AUTHORS.

4261. Ionospheric Transmission at Oblique and Vertical Incidence. G. Millington. *Phys. Soc., Proc.* 50. pp. 801-825, Sept. 1, 1938.—This paper gives a modification for a curved earth of Martyn's theorems, relating oblique-incidence ionospheric phenomena with observed conditions at vertical incidence. The theorems in their modified form are shown to hold, as regards both equivalent frequency and absorption, for a relatively thin layer above the earth's surface. It is assumed that the ionic density has the same vertical gradient everywhere between the transmitter and receiver, and the effect of the earth's magnetic field can be neglected. Methods of allowing approximately for these two factors are discussed. A set of transmission curves is derived, with which the skip frequency at any given distance from the transmitter can be obtained graphically from an observed *Pf* curve at vertical incidence. Similar curves are given for deducing equivalent heights and angles of elevation at oblique incidence, together with graphs of the maximum receivable frequency at extreme distances and the maximum distance of single-hop transmission, as functions of the height of the layer. The application of

the theorem is thus reduced, for the benefit of engineers, to a simple technique of using a number of standard curves in conjunction with a given P/f curve.

AUTHOR.

See also Abstracts 3044, 4011 and

3054B. Study of Ionosphere at Torrechiaruccia. A. Bottini.

3055B. Changes in Ionosphere during Aurora. B. Beckmann, W. Menzel and F. Vilbig.

3056B. Changes in Transmission Conditions for 10m. Waves, 1935-7. E. Fendler.

3058B. Experimental Research on Propagation of Ultra-Short Waves. W. Ochmann and H. Plendl.

3059B. Surmounting the Earth's Curvature by Ultra-Short Waves. G. Eckart and H. Plendl.

3060B. Diffraction Theory of Propagation of Ultra-Short Waves. G. Eckart.

3061B. Diffraction and Refraction of Radio Waves round Earth. T. L. Eckersley and G. Millington.

3062B. Electromagnetic Waves in Elliptic Hollow Metal Pipes. Lan Jen Chu.

PHOTOELECTRICITY.

*4262. New "Positive" Barrier Plane Photoelectric Effect and the New Barrier Plane Photo-Cell. B. Kolomiez. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 5. pp. 383-384, 1938. In English.—The action of barrier plane photo-cells is described. It has been found that thallium sulphide cells in which the ThS is in the state of electron conductivity exhibit a barrier plane photo-effect but with the inverse sign. Electrons thus pass from the metal into the semiconductor, charging it negatively. Such cells have a sensitivity which is 10 times as great as Se cells under the same conditions of illumination; the e.m.f. reaches 0.3 V; the dependence of the short circuit current and of the e.m.f. on the illumination do not differ from those of Se or Cu_2O cells whilst the spectral sensitivity is the same as that of the thalofides.

H. J. H. S.

See also Abstract 4264.

PIEZOELECTRICITY.

4263. Diffuse Scattering of X-Rays from Piezoelectrically Oscillating Quartz. G. E. M. Jauncey and W. A. Bruce. *Phys. Rev.* 54 pp. 163-165, Aug. 1, 1938.—Bertsch's investigation [see Abstract 1381 (1936)] of the effect of the different modes and types of piezoelectric oscillations of quartz on the intensity of Laue spots and Bragg reflections necessitates a similar investigation of the effect of the different modes and types of vibration on diffuse scattering. Extending the result found by Jauncey and Deming the authors find that in all cases the piezoelectric oscillations have no effect on the intensity of the diffuse scattering. Since the diffuse scattering cannot be affected by secondary extinction, it is concluded that the change of intensity of the Laue spots is due to a decrease of secondary extinction in the body of the crystal.

AUTHORS.

See also Abstract

2900B. Piezoelectric Measuring Apparatus. R. K. Hellmann.

THERMIONICS.

4264. Electron Movements at Exterior Boundary Surfaces. R. Suhrmann. *Zeits. f. Elektrochem.* 44. pp. 478-488, Aug., 1938.—This paper is limited to a brief review of the most important regularities of electronic emission at external boundary surfaces, after which the author considers some important problems of particular theoretical interest. The emissions first discussed are those from metals when heated

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to high temperatures *in vacuo*, and when submitted to light irradiation, to electronic bombardment and to the influence of strong electric fields. Then follows a discussion of the electronic properties of pure metallic surfaces, the dependence of the thermionic work function on the position of the element in the periodic system and on the orientation of the crystal faces, and the relationship to the electrochemical behaviour. Next the electronic properties of metallic surfaces which contain foreign atoms are treated, and the electrical state of the adsorbed atoms ascertained, this being important for the catalytic behaviour of metallic surfaces. By increasing the number of alkali metallic atoms on a metal surface, the thermionic work function is reduced until a value is attained somewhat below that for a monatomic coating but rises again to the value for a compact alkali metal. The mechanism of the electronic solution below and above the critical value is throughout different. Finally those emission properties which are important for technical purposes are described, e.g. photo-cells. Several analogies are pointed out between electric and photographic processes, and 15 diagrams with a Bibliography of 57 references completes a valuable paper. H. H. Ho.

4265. Work of Removal of Electrons from Metals. O. Klein and E. Lange. *Zeits. f. Elektrochem.* 44. pp. 542-562, Aug., 1938.—

This very comprehensive paper deals with the thermionic work function ($-a_0$) of metals under the following headings: (a) The present position of knowledge with respect to the $-a_0$ values of pure metallic surfaces. This section includes processes for the preparation of pure metallic surfaces; the $-a_0$ values of differently orientated single crystal surfaces; the influence of changes of modification of the whole phase on $-a_0$; temperature dependence of $-a_0$ at pure polycrystalline metallic surfaces; surface influences of vacuum distilled metals on $-a_0$; influence of mechanical treatment upon the structure of surface and thereby upon $-a_0$. (b) The influence of adsorption by impurities such as gases and vapours upon $-a_0$ values of metals. The gases and vapours studied were A, He, N₂, H₂, atomic H and H⁺ ions, O₂, CO, CO₂, H₂O, NH₃; the effect of a glow heat on the metal was investigated. (c) Methods for the measurement of Volta potential $\Delta\psi$ Hg/Me, with full experimental details. (d) The evaluation of the data, wherein 12 sets of curves and a table of results for 45 elements are included. In (e) the final data are assembled and a periodic chart constructed for the $-a_0$ values of the elements. The latter periodicity is then discussed. H. H. Ho.

4266. Contact Potential and Exit-Work. W. Heinze. *Zeits. f. Physik*, 109. 7-8. pp. 459-471, 1938.—The exit-work for the thermionic emission of electrons from W and Ta was determined from the slope of the Richardson line. The contact potentials of the same two metals with respect to W were measured by the thermionic-valve method. It was established that the difference in the exit-works equalled the difference in the contact potentials. W. S. S.

4267. Influence of Adsorption Layers upon the Impact of Positive Cæsium Ions in Tungsten. H. Paetow and W. Walcher. *Zeits. f. Physik*, 110. 1-2. pp. 69-83, 1938.—Previous investigators have noticed that electron liberation and ion reflection are greatly dependent on the condition of the surfaces, but Koch was the first to prove the alteration of the electron liberation and ionic reflection on the production of an alkaline layer [see Abstract 4424 (1936).] The author systematically investigates the influence of ad-atoms and surface compounds on the

phenomena mentioned. The number of the electrons set free on the bombardment of W with positive Cs ions is strongly increased by adsorbed layers. It is shown that additional electrons are set free from the ad-atoms. The number of the reflected electrons is likewise very much dependent on the existence of adsorption layers. For this the exit-work of the surface is decisive. J. J. S.

*4268. Engine for Smoothing Small Tungsten Wires. R. P. Johnson, A. B. White and R. B. Nelson. *Rev. Sci. Instruments*, 9, pp. 253-255, Aug., 1938.—The grooves left on drawn W wire by the diamond die cause difficulty in the interpretation of thermionic emission, adsorption and related phenomena. A machine is described whereby such grooves can be removed from wire 2-10 mils in dia. by mechanical abrasion. Automatic control is incorporated so that the machine runs continuously without attention except for changing the abrasive. The wire is stretched taut between two chucks geared together and the abrasive is pushed by a lead screw along the rotating wire. The marks left by one passage of the abrasive are crossed approximately at right angles on the return trip. The standard grinding schedule, occupying some 90 hr. in all, is described. A reduction of some 15% occurs in the dia. of the wire and whilst the finished wire tapers slightly from the centre towards the ends, it is claimed that a 25 cm. length cut from the middle of a 40 cm. ground piece shows a variation in mean dia. of less than 1%. A. G. Q.

THERMOELECTRICITY.

4269. Theory of the Thermoelectric Properties of Alloys. T. Muto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, No. 798, pp. 741-750, July, 1938. In English.—It is shown quantum-mechanically that for the electrical resistance of a metal or alloy the following classical expression is still valid at temperatures above Θ ; viz., $\rho = (m/Ne^2)(1/\tau)$, where N is the effective number of the electrons per unit volume (defined in accordance with the quantum theory of metals) and τ is the time of relaxation, which latter quantity is shown to be inversely proportional to the electron scattering probability due to the thermal motion of the crystal lattice, alloy formation, etc. Now Nordheim has shown quantum-mechanically that the expression for τ for an alloy has the form $1/\tau = 1/\tau_0 + 1/\tau_p$, provided the alloy consists of a single phase. τ_0 is due to the thermal vibration of the atoms situated at lattice points, as for a pure metal, while τ_p is due to the alloy formation from different kinds of atoms, the residual resistance being inversely proportional to τ_0 . It is shown that the thermoelectric power depends on the atomic concentration of the component metals of an alloy through the quantities τ_0 and τ_p . This is discussed in detail and comparison is made with experimental results. In particular the thermoelectric power of dilute solid solutions of the noble metals is dealt with, and also the reasons for the fact that the thermoelectric power of the noble metals is positive in sign, whereas the sign of the alkali metals is negative. J. J. S.

See also Abstract 4206.